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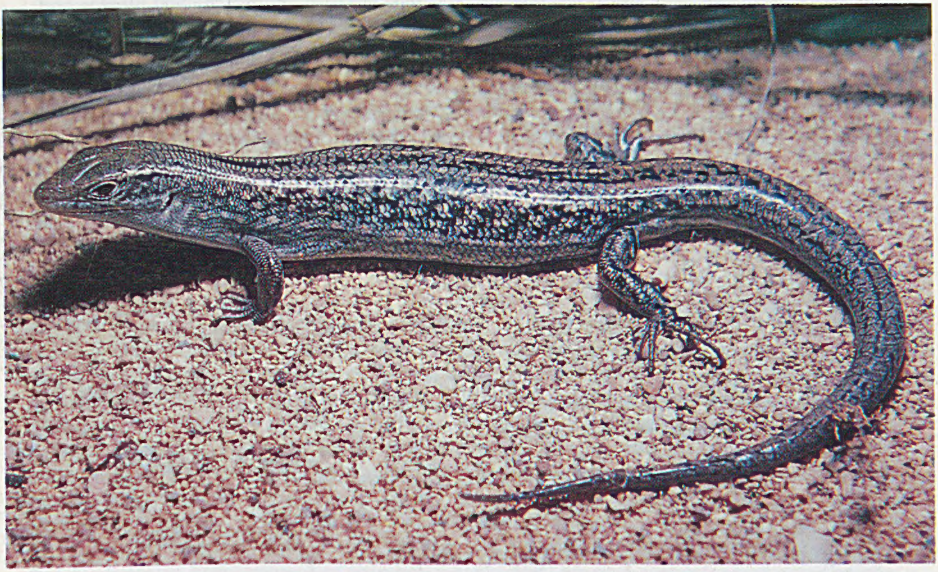

Ctenotus angusticeps from Airlie Island W.A. This species is the subject of a paper in this issue. (photo: Brad Maryan)

Male and female Eastern Lined - Earless Dragon *(Tympanocryptis lineata pinguicolla)* from Canberra, A.C.T. (photo: Will Osborne) This threatened sub species is found only in small areas of native tussock grassland that have escaped pasture improvement. A paper on this species appears in this issue.

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A CASE FOR DEREGULATION OF THE KEEPING AND TAKING OF REPTILES

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BACKGROUND AND THE PRESENT SITUATION

We have all heard about the serious environmental problems which have caused our herpetofauna populations to decline, causing populations to be placed at risk. These problems are, I consider, the most serious facing us today and challenge us to devise programs to reverse their impacts. This paper is about the second most important problem affecting herpetofauna, and that is the problems caused by the very regulations established to protect our fauna. They are relatively easy to rectify providing herpetologists continue to exert pressure on governments to bring about the necessary reforms.

To understand the reasons behind this problem, it is necessary to look at herpetologists themselves. Herpetologists are the most misunderstood of all naturalists. Snakemen such as Jim Morrisey, Fred Wade, 'Marco' Miller, Rocky Vane, Herbert Newcombe, Vic Hayden, Fred Fox, Tomahawk Joe [summarised in Cann (1986)] formed a colourful part of our history and set an image of reptile keepers that still lingers today. In opening the Australasian Herpetological Symposium in Sydney 1984, the President of the Royal Zoological Society of NSW, Mr R. Strahan, said *"Well-bred people .... have a distaste for amphibians and reptiles". "In short herpetology is not a respectable branch of zoology" .... "University zoology departments maintain their status by concentrating upon the respectable vertebrates" .... "So over the greater part of Australian history, the study of frogs and reptiles has been left largely in the hands of amateurs .... and it is significant that the first systematic treatise on Australian reptiles was written by a man who had never attended a university".* [Strahan (1985)]. Strahan also indicated that Australasian herpetology had (in more recent times) become respectable. It is my belief that the opinion of non-respectability of herpetologists, still resides today within the bureaucracies of state wildlife departments.

Just as *"well-bred people .... have a distaste for amphibians and reptiles"* herpetologists have an intense love for the study of reptiles and their conservation and would agree with D.H. Lawrence who wrote *"If men were as much men as lizards are lizards they'd be worth looking at".* With their love and devotion to herpetology, they are well placed to research, advise on and implement conservation strategies.

So where are we today? If efforts in herpetofauna conservation are going to be successful, there needs to be a high degree of support and co-operation between the statutory bodies and herpetologists from all levels. It would be expected that both work together closely. On the surface, this may appear to be the case, however a detailed analysis puts a different perspective on the issue. To date, government departments have ignored, (possibly because of herpetologists' poor image), almost totally, the conservation recommendations of both professionals and amateurs. Significant assessment and perceptions include: Tyler (1979), Rawlinson (1980), Mirtschin (1982), Ehmann & Cogger (1985), Greer (1989), Hoser (1989), Shine (1991), Mirtschin (1992).

The South Australian protective legislation for reptiles came into force in 1973. In the 20 years since there has been no assessment made to gauge the effect of this blanket type legislation in conserving South Australian fauna. The president of the National Parks Association, John Hunwick, has claimed that *"There is no place on Earth that has equalled the unenviable record of South Australians in bringing about the extinction of native land mammals".* (Kriven, 1990). Further Warren (1990) also claimed that European settlement in South Australia has wiped out 24 species of mammals within the state, giving it the worst extinction rate in the country. Also the News (1990) claimed that SA has an increasing number of species in danger of extinction.

There have been similar controls on the keeping, collection and transferring of native reptiles in most states for 10 to 20 years, the only difference is that some states allow more keeping and taking than others. Blanket legislation is a problem throughout Australia. In most of the recent analyses of herpetofauna conservation carried out by both professionals and amateurs, there have been many environmental factors identified in causing pressure on our native herpetofauna. Within herpetological ranks, there has never been any great support among herpetologists for the mounting of legislative protection, or support, for the system as it is in Australia today. There have been many claims that blanket protection is counter-productive:

"I know of absolutely no grounds to justify or necessitate legislation to control the taking of frogs anywhere in Australia except for the handful of endangered species". (Tyler, 1979).

".... Australian wildlife legislation in most cases is primarily aimed at controlling the collecting of specimens, and Tyler's comment (1979 - above) "is equally valid when applied to reptiles". (Rawlinson, 1980).

"With the possible exception of crocodiles and some marine turtles in northern Australia, and perhaps some local populations of lizards, frogs and tortoises in the south, reptile and frog populations in Australia are rarely endangered by direct human exploitation of the animals as a resource, i.e. by hunting for skins or for pleasure, or being captured alive for the local pet or education market". (Cogger, 1983).

"The new SA NPWS policy on permits is more for the sake of administration than reptile welfare". (T. Houston pers. comm).

"There is widespread concern about the effects that protective legislation (and more so the way it is being implemented) is having on herpetology in Australia". (Herpetofauna 1976).

The existing wildlife regulations "tend to discourage amateur herpetologists and students, and alienate many of those who would otherwise be strong supporters of long-term conservation measures". (Ehmann and Cogger, 1985).

"Alteration of habitat was recognised as the major cause of decline in wildlife populations; of far greater significance than direct exploitation of wildlife by man". (Fox report 1974).

With this weight of scientific and amateur opinion, one would imagine that the way in which wildlife was managed in this country would reflect the view of the experts. Unfortunately the wildlife statutory bodies have to date apparently ignored these analyses and opted for systems that have resulted in the second biggest problem facing wildlife conservation in this country. This is the impedance of the acquisition of the life history details and data needed for effective conservation and management.

There seems little value in prosecuting herpetologists for illegally keeping reptiles and frogs whose status is not at risk. To enforce reptile and frog protection at present involves inspections, confiscations, keeping of confiscated animals by NPWS, preparing court briefs, court appearances, clerical support and public relations activity. Instead of pursuing this futile work (which has never been shown to do anything for conservation of herpetofauna other than peg it back), these resources should be put into developing and maintaining a herpetofauna status list, surveying populations, captive breeding endangered species and providing support for other groups, societies and private individuals interested in conservation programs. This would be a far more effective use of the limited resources.

A SOUTH AUSTRALIAN SURVEY (with Australia-wide implications):

To assess the feeling toward the regulations and the way they are being managed in South Australia, a survey of 60 mostly South Australian amateur and professional herpetologists was carried out between November 1990 and February 1991. Twelve questions compiled by the author with the help of S.A.H.G. were provided to each participant with anonymity guaranteed

in compiling the responses. In questions 3 to 10, participants were asked to assign their answer a score out of 10. A score of 1 represented a strong score in the negative, a score of 10 indicated a strong score in the affirmative.

Q1 Have you ever or do you currently keep reptiles and/or amphibians?

59 responded. 53 (89.8%) answered Yes. 6 (10.2%) answered No.

Q2 How many years have you been interested in herpetology?

55 responded, an average of 14.00 years. The range was from 1-5 years (16 respondants) to > 31 years (2 respondants).

Q3 Do you think the regulations controlling the collection of reptiles in South Australia are effective in protecting wild populations?

52 responded. An average of 3.63 out of a possible score of 10 was recorded. The range was from 1 (11 respondants) to 10 (2 respondants).

Professionals and amateurs agree that the only way to effectively preserve herpetofauna, is to adopt a holistic approach. Trying to preserve herpetofauna by monitoring and regulating the "trade" cannot possibly reflect the dynamics of the wild populations. To understand the factors involved in conservation of any species, it has to be monitored in the wild. Ehmann and Cogger (1985) have estimated that 99.77% of annual mortality is due to natural causes and the remainder due to man induced mortality. This is made up of 0.14% to roadkills, 0.08% to scrub clearing, 0.0005% due to collecting for research and 0.0005% due to collecting for seasnake skins and amateur collecting. Cogger (pers. comm.) has estimated that about half of the last figure would be due to amateur collecting i.e. 0.00025%. This means that throughout Australia, for every reptile collected by amateurs, there are an additional 880 killed on the roads or due to scrub clearing. Although probably highly conservative, these figures put the question of amateur collecting in its true perspective. Taking the argument a step further, if governments really wanted to be effective in preserving herpetofauna, they would put 880 times their resources into reducing this figure than into controlling amateur collecting.

Q4 Do you think there should be a closer working relationship between the NPWS and herpetologists?

59 responded. An average score of 9.14 was recorded with a range from 2 (1 respondant) to 10 (37 respondants). This is a strong indication that the current working relationship between herpetologists and the NPWS is deficient.

Q5 In any dealings with NPWS, do you think your enquiries have been dealt with adequately?

49 responded. An average score of 5.18 was recorded with a range from 1 (10 respondants) to 10 (3 respondants). It is significant that this question attracted the lowest number of respondents in the survey. This could indicate that there was less involvment in this area than others dealt with in the survey. The average suggests that there is ample room for improvement.

Q6 Do you think that in trying to protect all species that the limited resources of NPWS may be misdirected?

51 responded. An average score of 7.84 was recorded with a range from 1 (1 respondant) to 10 (16 respondants). This indicates that the system requires changing to one in which optimum use of resources is achieved.

A deregulated system of protection that concentrates on endangered, threatened and vulnerable species would minimise *"... legislative emphasis on individual taxa ..."* which *"in the great majority of cases ... is not only ineffectual and cost-inefficient in conservation terms, but is often counter-productive because it gives the appearance of conservation action where none really*

exists". (Cogger pers. comm). Current legislative emphasis on blanket legislation is not only a facade but it is dishonest.

Q7 Do you think amateurs make a valuable contribution to herpetology?

59 responded with a range of 1 (1 respondant) to 10 (41 respondants). An average score of 9.05 was recorded. This indicates that there is a very strong opinion that amateurs make a valuable contribution to herpetology. A survey of popular books within the field of herpetology written in the last 25 years in Australia reveals that amateurs have made a larger contribution than professionals.

There has been a significant contribution by amateurs at the three Herpetological Symposiums in Melbourne, Sydney and Brisbane. Clearly the statutory bodies should recognise that amateurs are contributing to our knowledge, and thus the conservation of herpetofauna and therefore should be given at least equal opportunity and encouragement to further their activities as is given to professionals.

Q8 Do you think the NPWS laws are enforced too heavily in some cases?

55 responded with a range of 2 (1 respondant) to 10 (24 respondants). An average score of 8.25 was recorded. This score again strongly emphasises the need for change. Here are four examples which may be typical of the type of incidents reflected in these figures.

1) About 2 years ago a person came to me for help after being asked to pay a fine for failure to keep his records in a manner suited to the NPWS. His only error had been to enter each new record concerning the same species on a new page rather than having them all on the same page. The individual had kept his snakes in an immaculate condition but has the misfortune to be dyslexic which made bookwork a far more difficult task than for most. When I took the matter up with the department, they abandoned the fine.

2) In August 1990, while two South Australian herpetologists were returning from a holiday in the Northern Territory, they were tracked by aircraft, stopped by a NPWS road block and asked to lay on the ground with guns directed at their heads while being searched. There may have been justification to stop them under the current regulations for questioning, since both men were known to the NPWS. But with no previous history of violence, this incident surely falls into the category of being completely "over the top".

3) In a court case in October 1990 involving an offence against the NPWS Act, R. McInnes, the Stipendiary Magistrate, made these comments: *"It does no credit to the Department that members of voluntary organisations supplementing the work of the Department feel that they can only discuss administrative policies in a criminal court"* - McInnes (1990).

Q9 Do you think the NPWS should be more positive to the keeping of reptiles in captivity?

56 responded with a range of 1 (1 respondant) to 10 (30 respondants). An average of 8.57 was recorded. There is a need for the current administration to have a better understanding of the need to keep more reptiles in captivity. At the moment, the NPWS is trying to minimise the number of reptiles "traded". I believe they do not comprehend the benefits to conservation by keeping reptiles in captivity. The emphasis is on reducing the numbers of species in "trade" rather than encouraging herpetologists to keep a wide variety of reptiles for study. To say they can use the scientific permit system is hardly realistic. Many features of herpetofauna are discovered by casual observation without any systematic effort. For example, the gastric brooding frog's method of birthing was discovered by chance (Tyler 1984).

Q10 Do you think the laws restricting access to wild reptiles need serious revision to allow greater access to a greater number of people?

56 responded with the range from 1 (3 respondants) to 10 (19 respondants). An average score of 7.39 was recorded. There is a need to deregulate the laws so that herpetology is better

served. Conservation of herpetofauna depends on herpetology having a solid foundation. The current policy is not to allow animals into "trade" that are not there already. This has stopped many herpetologists keeping and studying those species not already in the "trade".

Q11 Do you think there is a case for deregulating the collection of certain species of reptiles that are not in any danger of becoming threatened?

56 responded. 49 (87.5%) replied Yes and 7 (12.5%) replied No.

Q12 Did you get your interest in reptiles by first keeping them in captivity?

57 responded. 35 (61%) responded Yes and 22 (39%) responded No.

SYNTHESIS AND FUTURE DEVELOPMENTS

There is one further point to make and that is the economic argument. It should be apparent from both Federal and State positions that financial resources are decreasing. It is important that conservation effort be put in true perspective. Jenkins (1985) claims that *"the economics of conservation are such that governments must necessarily allocate priorities"*. It is a scandalous waste to be pursuing blanket regulations when it is obvious that they are ineffective in preserving native herpetofauna and that they alienate so many people. On a larger scale, there are nine statutory bodies involved with fauna conservation in Australia. For cost efficiency and a more co-ordinated approach, these operations need streamlining and rationalising.

One of the biggest problems with the current system is that there are no performance indicators which measure the success or failure of the system in terms of population status of reptiles. It is known that some species have declined since legislative measures were introduced over the last 20 years. Any new proposal should establish a monitoring system that would alert us to population declines.

The role of National Parks and Wildlife Services must change from being head bangers to that of supporting reptile keepers and encouraging them to study and report their observations both from in the wild and in captivity. They must also be tolerant of those that don't fit their own concept of keepers. There must be an acceptance that there will be a spectrum of standards. Rather than use the big stick to try and raise the standards, assistance to those more in need of help should be supplied. This will require a change from the traditional role of NPWS officers. Firstly it will mean that they must raise their own knowledge of reptiles. It will mean that they must be aware of the various areas of expertise in the State and make use of those resources. Those resources could be contracted where necessary to provide training or information both to NPWS or the public. A knowledge of who is doing what and acting as advisers and facilitators. In other words being true public servants, not oppressors and repressors.

It is hoped that in South Australia we can create a model system of keeping that complements conservation effort. This would include the following elements:

1. Increased study and understanding of reptiles and frogs by those with an active interest.
2. Increasing public awareness of the diversity of reptiles and frogs in Australia.
3. A demotion of keeping exotic animals as pets e.g. cats, dogs, mice etc. and keeping native animals as an alternative, especially reptiles.
4. Appreciation by everyone of the big problems affecting conservation rather than parading the facade promoted by statutory bodies.

Once this proposed system is established and on the way to becoming reality, ultimately, the aim should be to examine closely the combining of all environment statutory bodies throughout Australia with the view to having one system throughout, instead of nine statutory bodies all with different Acts and ideas of conservation.

In 1993, the Second World Congress in Herpetology is to be held in Adelaide. It would set an example if we had a commitment to a model system by that time.

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A RANGE EXTENSION FOR THE SCINCID LIZARD *CTENOTUS ANGUSTICEPS* OF NORTHWESTERN AUSTRALIA

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The scincid lizard *Ctenotus angusticeps* was recently described (Storr, 1988) from 4 specimens from Airlie Island (21°20'S x 115°10'E) off the northwest coast of Western Australia. The species was placed on the list of endangered species in Western Australia as early as 1990, presumably because of its restricted distribution.

Observations on the ecology of the species were published by Browne-Cooper and Maryan (1990) who visited the island for 2 days in March of 1990. Here the species was observed in all vegetation types present on the island including Acacia shrubland, coastal spinifex, and tussock grass, but showed a marked preference for an expanse of tussock grass (of an unknown species) at the western end of the island. Given the small size of the island (0.28km sq.) and restricted nature of its distribution Browne-Cooper and Maryan believed the species to be threatened by the activities of the Western Mining Company which have oil storage and processing facilities on the island.

The purpose of this paper is to communicate the discovery of *C. angusticeps* approximately 800km north of Airlie Island at Roebuck Bay south of Broome. At this location it was found in a very unusual habitat, coastal samphire flats.

Figure 1. Samphire flats at "Thangoo" on Roebuck Bay

Figure 2. Close-up of samphire habitat showing the patchwork like distribution of the shrubs.

The location at which the following observations were made is "Thangoo" a beef property on the southern shores of Roebuck Bay. The vegetation of the general area is Acacia woodland/scrub on red sandy soils which close to the coast changes abruptly to large expanses of samphire on dry, fine, grey soil or close to tidal influence to mud. Mangroves border the estuary and high tide verge. The area was visited over a two day period in late August of 1990, i.e. towards the end of the northern dry season. During this time *C. angusticeps* was recorded from muddy samphire flats close to the coast. The adjacent dry samphire plains were not visited so its occurence in this considerably more extensive habitat is unknown. It was not recorded during the course of searching the nearby acacia woodland/scrub. The observations made are from a relatively confined area, a strip of shrubland approximately 25 metres either side of a narrow track over a distance of approximately 75-100 metres, and were carried out over the mid to late morning through to early afternoon hours (ca. 10am-3pm). The only noticeable trend in the lizards' activity was its apparent lack in the earlier hours of the morning (from around 10-11am), which differs markedly from the early to mid morning (7-9am) activity peak recorded by Browne-Cooper and Maryan on Airlie Island. However their observations were made during very hot weather conditions whereas the observations reported here were probably made under more temperate conditions. The most striking aspect of behaviour of this species was its elusive nature. When pursued most individuals kept clear by a distance of several metres, continually running from the shelter of one samphire shrub to another. Only rarely would they allow close approach to a sheltering site and even more rarely would they break their flight in an open space between sheltering sites. Consequently the individuals at this site were difficult to both observe and identify.

A sample of 7 specimens was collected for morphological investigation, 5 of these are lodged in the Australian Museum, Sydney (AM R136035-37 & R135264-65), and 2 in the Western Australian Museum, Perth (WAM R108260-61). The specimens from Roebuck Bay seem to differ slightly in colour to the individuals depicted in the papers of Storr (1988) and Browne-Cooper and Maryan (1990), some individuals having a more muted colour pattern overall, a feature that reflects the tones of the substrate and vegetation they inhabit.

Figure 3. *Ctenotus angusticeps* from "Thagoo" on Roebuck Bay.

The discovery of *C. angusticeps* at Roebuck Bay has extended the potential range of the species to a considerable portion of the northwest Western Australian Coast. Further field collecting in the intervening areas between Airlie Island and Roebuck Bay is now required to determine whether the species has a more or less continuous distribution along the coast or whether the two known populations remain disjunct.

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SIZE DIFFERENCES BETWEEN POPULATIONS OF *HOPLODACTYLUS MACULATUS* IN CANTERBURY, NEW ZEALAND

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ABSTRACT

Snout - vent lengths (SVLs) of common geckos *(Hoplodactylus maculatus auct.)* were measured at a number of localities in Canterbury, New Zealand. Geckos from Banks Peninsula localities are significantly larger than geckos from Kaitorete Spit and Motunau Island. This difference in size is thought to be due to the interaction between microhabitat structure and mammalian predation.

1.0 INTRODUCTION

The common gecko *(Hoplodactylus maculatus auct.)*[1] is a small to medium sized nocturnal gecko that is distributed over most of New Zealand. It is especially abundant east of the main divide in the South Island (Pickard and Towns, 1988), where it is found from sea level to 1700m in a variety of habitats (Bull and Whitaker, 1975). In Canterbury common geckos live under rocks, logs, and building debris as well as in steep rock faces, rock tumbles and road cuttings.

Despite habitat destruction, habitat modification and mammalian predation, the common gecko is still considered to be the most widespread and abundant gecko in New Zealand (Robb, 1986; Gill, 1986). The maximum density of one mainland population at Turakirae Heads, Wellington, has been estimated at 4000 individuals/hectare (Whitaker, 1982). In Canterbury, wherever suitable habitat exists these geckos are common (pers. obs.).

Between December 1990 and June 1992 the snout-vent lengths (SVLs) of common geckos were recorded from a number of different localities in Canterbury, New Zealand. These measurements were collected incidentally to another ongoing study.

It became apparent that there was a significant difference between the lengths of common geckos found on Banks Peninsula compared to those animals captured on Kaitorete Spit. Common geckos from Motunau Island were significantly different from both the Banks Peninsula geckos and those found on Kaitorete Spit although they were much closer in size to the Banks Peninsula animals. This difference may result from the interaction between microhabitat structure and mammalian predation.

2.0 METHODS

Animals were captured by hand, at their daytime retreats by turning rocks and wood debris or by "coaxing" animals out of rock crevices. SVLs, accurate to 1.0mm, for all the animals were taken with a clear plastic ruler. Where possible the sex of each gecko was also noted. Mature males could easily be identified by the presence of hemipenal sacs and preanal pores, those animals not displaying these sexual characteristics but of similar size were assumed to be females. Weights of some animals were taken using a 10gm Pesola® spring balance. Immediately after measuring the geckos were released at the site of capture.

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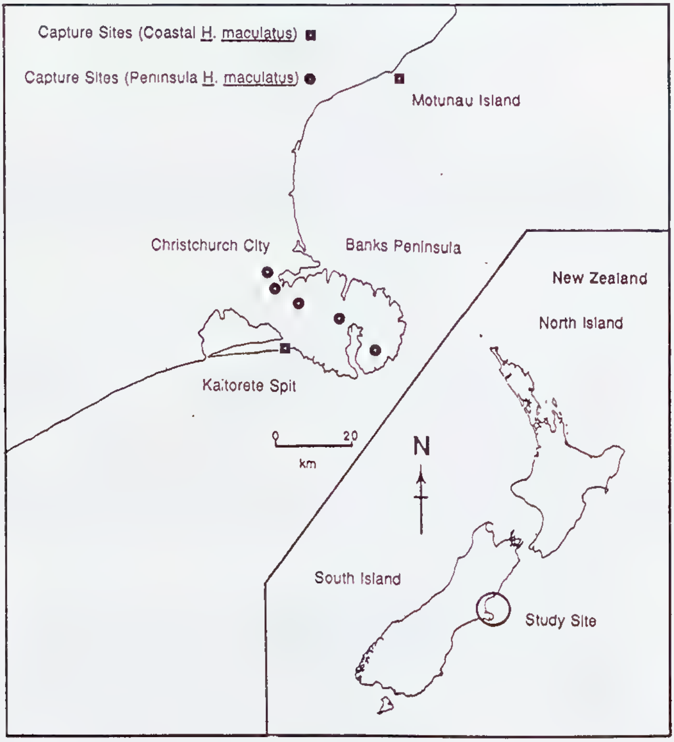
[1] *H. Maculatus auct.* is now recognised as a complex of cryptic species (R. Hitchmough pers. com.). Therefore in the context of this article the name "common gecko" refers to all taxa currently recognised as *H. maculatus*. The geckos studied at Banks Peninsula, Kaitorete Spit and Motunau Island are considered to be the same species (R. Hitchmough pers. com.).

3.0 STUDY AREAS

Common geckos were caught at six localities on Banks Peninsula, and at two coastal sites, Kaitorete Spit and Motunau Island (Fig. 1).

Fig 1: Distribution of sites where geckos were captured for measurement.



3.1 Banks Peninsula

Banks Peninsula is of volcanic origin and is topographically steep with high-sided gullies, rocky bluffs and high ridges. Formerly densely forested, the Peninsula is now a mosaic of tussock grassland, pasture and scrub. Geckos were captured in crevices on rocky bluffs or under rocks in rock tumbles. All capture sites were surrounded by semi-developed tussock grassland and scrub and ranged in altitude from 300m ASL to 660m ASL.

3.2 Kaitorete Spit

Kaitorete Spit extends westward from Banks Peninsula for approximately 18 kilometres, bordered by the Canterbury Bight on one side and Lake Ellesmere on the other. Along the spit are a series of coastal terraces covered with pasture grass, low scrub *(Coprosma propinqua, C.rigida)*, and scramblers *(Muehlenbeckia complexa, Rubus squarrosus)*. In front of these terraces there are dunes which support two species of sandbinder, the native pingao *(Desmochenous spiralis)* and introduced marram *(Ammophila arenaria)* (Mason, 1969). These dunes flatten out to form foredunes before descending to a steep shingle beach. The animals were caught amongst driftwood and debris on the foredunes and under building and other debris on the shrub covered terraces.

3.3 Motunau Island

Motunau Island is less than two kilometres from the North Canterbury coastline (Cox *et al.*, 1967). The island consists of a flat plateau approximately 40 metres ASL surrounded by steep slopes and cliffs. On the southern and eastern coasts of the island are two small grass-covered flats close to sea level. Approximately 3.7 hectares in size, Motunau is covered in long grass and tussock with some small areas of scrub. The geckos were captured under rocks and drift wood just above the drift line of the beach and on the grassy flats. One animal was also caught on the plateau.

4.0 RESULTS

Only the SVLs of mature animals were used in the analysis. As the smallest animal that could unequivocally be regarded as a male (a gecko from Kaitorete Spit in the Canterbury Museum collection) measured 50mm SVL animals with SVLs less than this length were excluded from the analysis.

Forty five geckos were captured at the three localities and 11 preserved geckos from Kaitorete Spit (Canterbury Museum Rep 225) were also examined (Table 1).

Table 1. Analysis of SVL's of *H.maculatus* from Kaitorete Spit, Motunau Island and Banks Peninsula.

LOCALITY	N	SVL (mm)		
		Mean	SD	Max.
Kaitorete Spit[1]	17	61.5	3.81	68
Kaitorete Spit[2]	11	52.3	4.52	66
Motunau Island	8	69.0	4.84	74
Banks Peninsula	15	71.6	6.99	80

[1] Live geckos measured Dec., 1990 - June, 1992.
[2] Preserved geckos in Canterbury Museum (CM Rep 225)

Of those Kaitorete Spit geckos with SVLs above 50mm, none was larger than 68mm whereas 14 (93.3%) of the 15 geckos from Banks Peninsula had SVLs greater than 68mm. The Motunau Island geckos show size ranges approximately mid-way between the other two samples (Fig. 2). An analysis of variance indicates that all three samples are significantly different from each other (ANOVA $p < 0.01$).

Of the eleven common geckos collected from Kaitorete Spit in 1950 (CM Rep 225) 10 of the 11 animals had SVLs < 60mm. Distortion and shrinkage as a result of preservation meant that these measurements were not as accurate as those taken from live animals.

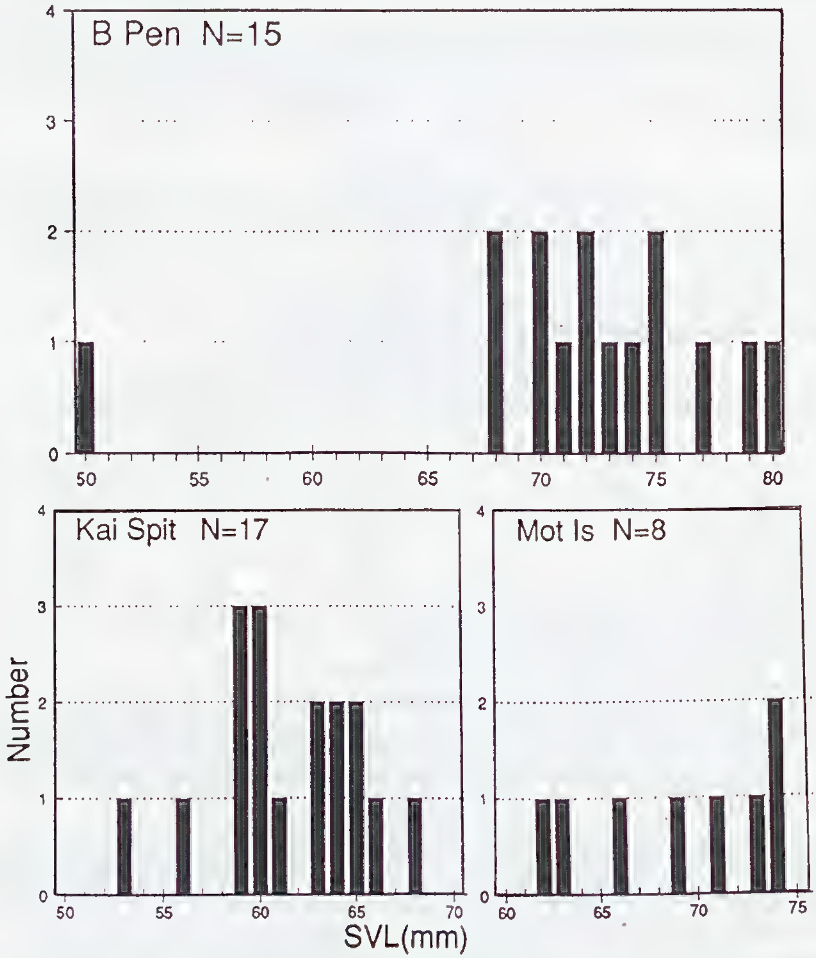
5.0 DISCUSSION

The differences found in SVLs are no doubt accentuated by the incomplete size range of Banks Peninsula geckos, an artefact of the habitat in which these animals were captured. Smaller animals tended to evade capture more easily than larger animals by withdrawing further into crevices, whereas at the coastal sites the lifting of material that acted as refuges exposed all the animals present to collection, regardless of their size. However, despite this collection bias, it is clear that common geckos in parts of Banks Peninsula attain a larger size than common geckos on Kaitorete Spit.

There are a number of possible explanations for the observed size difference:

a) less severe microclimatic conditions (compared to Kaitorete Spit) on Banks Peninsula and Motunau Island, may increase foraging time, lengthen the growing season for animals and/or increase longevity by decreasing population turnover.

Fig 2: Comparison of SVLs of *H.maculatus* from Banks Peninsula (B Pen), Kaitorete Spit (Kai Spi) and Motunau Island (Mot Is). Only animals with SVL's > 50mm reported.



b) prey; abundance, diversity and nutritional content may vary between the "large gecko" sites on Banks Peninsula and Motunau Island and the "small gecko" sites on Kaitorete Spit,

c) the impact of mammalian predation may be more severe on larger geckos at Kaitorete Spit than on Banks Peninsula.

While there is little data available to support the first two explanations, there is some circumstantial evidence for the predation hypothesis based on research carried out in New Zealand, especially on offshore islands.

Both of the mainland sites (Banks Peninsula, Kaitorete Spit) have a suite of introduced mammals which are known lizard predators, including mice *(Mus musculus)* (Murphy and

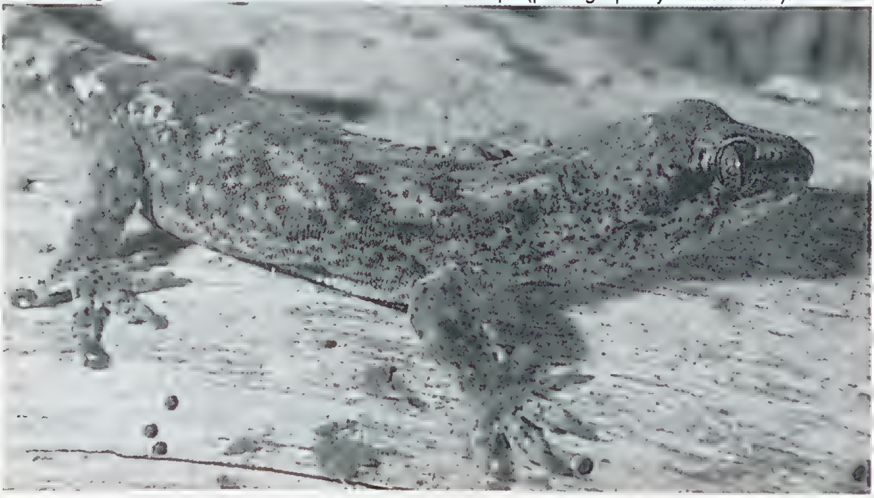
Pickard, 1990), rats *(Rattus rattus)* (Innes, 1990), feral cats *(Felis catus)* (Fitzgerald, 1990) and mustelids (*Mustela erminea* and possibly *Mustela furo*) (King, 1990; Lavers and Clapperton, 1990). All of these species are European introductions and would have become established in the last 200 years, succeeding kiore *(Rattus exulans)*, which were almost certainly present during the 1000 years of Polynesian settlement which preceded the arrival of Europeans in New Zealand (Atkinson and Moller, 1990). Motunau Island has no mammalian predators.

A relationship between the vulnerability of lizards to predation and microhabitat structure has been reported by a number of authors (Whitaker, 1978; Towns *et al*, 1985; Towns and Robb, 1986; Towns, 1991). For example, the gecko *Hoplodactylus duvaucelii* is now confined to offshore islands. On those islands which are free of introduced predators, *H. duvaucelii* occupies a variety of habitats including forest, forest fringes/scrub, boulder beaches and cliffs (Towns *et al*, 1985). However, on islands where this species occurs sympatrically with mammalian predators (most often the kiore, *R.exulans*), *H.duvaucelii* is invariably confined to cliff faces and rock tumbles, where the structure of the microhabitat is thought to give *H.duvaucelii* some protection from predators (Whitaker, 1978).

The habitat in which the larger Banks Peninsula geckos were found was similar to that in which *H.duvaucelii* find refuge on islands with predators. All the large common geckos from Banks Peninsula were captured either in rock crevices in cliff faces or under rocks in rock tumbles. On the other hand the Kaitorete Spit animals were captured under rotting logs, building material or amongst wood debris both in the dunelands and on the shrub covered terraces. These micro habitats appeared to be less substantial, more ephemeral and offered less protection from predation and disturbance than the rock refuges used by the common geckos on Banks Peninsula.

Analysis of lizard populations resident on offshore islands suggests that large species are more vulnerable to predation than smaller species, as are species which forage in the open compared to those that forage under cover (Whitaker, 1978). There is also evidence that predators may preferentially predate larger individuals in prey populations (Case, 1978). In coastal Kaitorete Spit, it is possible that large size in common geckos is a liability as large animals are less able to avoid predation by finding cover that is inaccessible to predators and are more obvious to predators when habitat is disturbed. Similarly, because of the more open nature of the coastal habitat larger geckos may also be more susceptible to predation when foraging. No equivalent of the "predator secure" crevice/rock tumbles exists on Kaitorete Spit.

Fig 3: A female *H.maculatus* from Kaitorete Spit (photograph by John Marris).



Studies on the ecology of common geckos at Turakirae Head, Wellington indicated that this species, especially the adults, were very sedentary. Their home range size was very small with the average movement being around one metre (Whitaker, 1982). In rocky crevices and boulder banks on Banks Peninsula it is likely that once an individual animal has taken up residence in "predator secure" microhabitat they are never far from the vicinity of that refuge. It is therefore quite possible that individual geckos in this type of microhabitat remain resident at the same "predator secure" site for many years enabling these long term residents to grow to a large size in relative safety.

The geckos captured on Motunau Island while closer in size to those found on Banks Peninsula than to those found on Kaitorete Spit were caught in habitat similar to that in which the geckos from Kaitorete Spit were captured. Motunau Island is free of mammalian predators, thus enabling the larger geckos to survive in micro habitats in which they would be unlikely to persist on the mainland.

There are two possible predator induced processes that are creating the size differences observed between Kaitorete Spit geckos and those from Banks Peninsula. Either predation is removing from the Kaitorete Spit population the largest cohorts which are those most susceptible to predation, in effect predation pressure is so intense that Kaitorete Spit animals do not live as long as the Banks Peninsula geckos, or, over a period of time selection for small size as a result of predation has reduced the average size of the Kaitorete Spit animals across the whole population. The latter would seem unlikely if the cause is mammalian predation as these have only been present in New Zealand for less than 1200 years.

One way of testing the influence predators have would be to take animals from both Banks Peninsula and Kaitorete Spit and maintain them in captivity, free from predation, under identical environmental conditions. By monitoring growth, size at sexual maturity and overall population size of mature animals it should be possible to establish if size difference in common gecko populations is genetically programmed or results from specific environmental factors.

6.0 CONCLUSION

Data collected from a number of localities in Canterbury indicated that common geckos resident on Banks Peninsula were larger than the same species from Kaitorete Spit. This size difference is thought to occur as a result of the Banks Peninsula animals living in more "predator secure" microhabitat than the Kaitorete Spit geckos. Support for this relationship comes from studies of lizard species present on offshore islands. These studies have indicated that the vulnerability of lizards to predation is often related to microhabitat structure, and that larger lizards are more vulnerable to predation than smaller lizards.

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RECENT RECORDS OF THE EARLESS DRAGON *TYMPANOCRYPTIS LINEATA PINGUICOLLA* IN THE CANBERRA REGION AND A DESCRIPTION OF ITS HABITAT

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SUMMARY

The Southern Lined Earless Dragon *Tympanocryptis lineata pinguicolla* was re-discovered in 1991 near Canberra after not being recorded in the area for over thirty years. The lizards are now known from two locations in the ACT and a single site close by near Queanbeyan in NSW. They were found on open plains that were treeless grasslands at the time of European settlement. Although two of the three locations were lightiy grazed by sheep, all sites have had a land-use history involving minimal pasture improvement. Most individuals were captured at a location which had been protected from grazing for over 30 years. Preliminary results indicate that the lizards are associated with native tussock grasslands dominated by the grass genera *Danthonia* (wallaby grasses), *Stipa* (spear grasses) and *Themeda* (kangaroo grass). They were not found in areas where the taller tussock grasses formed extensive intact swards but rather occurred near the edges of such swards in areas where the ground cover was sparser or had shorter grasses such as *Danthonia* spp. Several adults found sheltering beneath deeply imbedded boulders appeared to be utilising abandoned arthropod burrows. The re-discovery of *T.l. pinguicolla* has implications for the conservation of native grasslands in the region and further research and survey on this threatened subspecies is required.

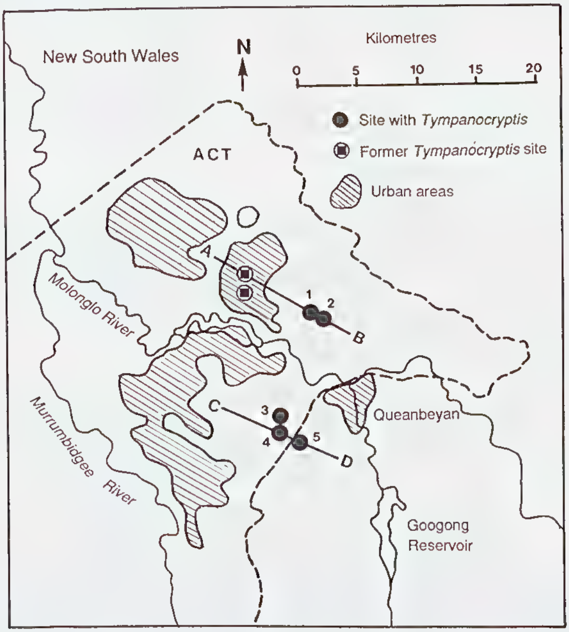
INTRODUCTION

The Lined Earless Dragon *Tympanocryptis lineata* is a small agamid found throughout much of the interior of Australia (Cogger, 1983). The species as currently defined is quite variable and five subspecies are recognised (Mitchell, 1948; Storr, 1982; Wilson and Knowles, 1988). One of these, the south-eastern race *T. lineata pinguicolla,* is known only from parts of southern and central Victoria and from Cooma in the Southern Tablelands of New South Wales (Mitchell, 1948). Although Jenkins and Bartell (1980) recorded *T. lineata* from Canberra, they declined to include it in the subspecies *pinguicolla* because they considered that the taxonomic characters used by Mitchell may not have been consistent. They suggested that since *lineata* is continuously distributed across much of southern Australia, the population at Canberra can be assigned to the nominate subspecies.

We have examined specimens from Canberra, Cooma, Bathurst and the Melbourne region and have found little difference between them (Osborne, Kukolic and Blackburn, unpublished data). Specimens from all of these locations match the descriptions of *T.l. pinguicolla* given by Mitchell (1948). We have also examined specimens of *T. lineata* from other parts of Australia including western New South Wales and South Australia and have found them to differ consistently from *pinguicolla*. Of the differences discussed by Mitchell, our measurements indicate that only two features of *T.l. pinguicolla* consistently separate this subspecies; these are the presence of a slight to pronounced lateral skin fold between the axilla and groin (absent in *lineata*), and the presence of more numerous enlarged dorsal tubercles which are very elongated with basal length shorter than height (broader and not as high as *lineata*). Another conspicuous feature of *T.l. pinguicolla* is the presence of very narrow light-coloured dorsal stripes. However, narrow stripes are also found on some specimens of *T. lineata* from other areas (e.g. Houston, 1978). There is a need for further revision in this group but for the purposes of this paper *T. lineata* from Canberra will be referred to as *T.l. pinguicolla.*

Although early records indicate that *T.l. pinguicolla* was once abundant in areas where it occurred (McCoy, 1889; Lucas and Frost, 1894) it has declined in all areas (Land Conservation Council, 1985; P. Robertson, pers. comm.). Concern about the conservation status of the subspecies resulted in it being listed as endangered in Victoria (Brereton and Backhouse, 1993). In New South Wales the distribution of the subspecies is poorly known and requires further survey. In the ACT *T.l. pinguicolla* was known previously from North Canberra at several sites adjacent to Northbourne Avenue (Fig. 1) (R. Jenkins and G. Young, pers. comm.).

Figure 1. Location of sites where lined-earless dragons *(T.l. pinguicolla)* were captured in the Canberra region. Lines A-B and C-D indicate locations of topographic profiles shown in Fig. 2. Site positions on these transects are indicated by their site number.



In the Melbourne region the lizards have been collected from many locations, most of which have now been destroyed by urban development. The habitat of the dragons in Victoria has not been described previously, but the few observations available indicate that they were found amongst basalt stones on grassland plains (McCoy, 1889; Robson, 1968). Recent sightings north of Melbourne have all been from open stands of *Themeda* grassland on exposed stony crests and rocky stream escarpment (Brereton and Backhouse, 1993).

At Bathurst in NSW *Tympanocryptis* were commonly observed 25 years ago in areas that were probably native grasslands (G. Waters, pers. comm.). These areas are now within the suburbs of Bathurst, but examination of the few remaining undisturbed sites indicates that the grasslands were probably dominated by *Danthonia* spp. (wallaby grasses) and/or *Themeda* (kangaroo grass) (W. Osborne and K. Kukolic, unpublished data). Jenkins (pers. comm.) describes the original Canberra collection site as being on a low rise, in a grazed paddock, which supported unimproved pasture dominated by tussock grasses and occasional stones. The dragons were captured as they scuttled between the tussocks (also see Jenkins and Bartell, 1980).

Earless dragons had not been recorded in the Canberra region for over 30 years until the summer of 1991-92 when we collected *T.l. pinguicolla* at three locations. All sites where the lizards were captured are grasslands dominated by native species. In this article we present preliminary field observations on the subspecies and provide a description of the grassland habitats they occupy. A subsequent paper will report on their genetic status, morphology and population ecology.

METHODS

Reptile surveys have been conducted for several yeas by the ACT Parks and Conservation Service in the ACT and region (Osborne *et al.*, 1991; Williams and Kukolic, 1991). The objective of this work has been to survey populations of uncommon and threatened reptiles including the pygopodids *Aprasia parapulchella* and *Delma impar*, and the locally rare *T.l. pinguicolla*.

Two main techniques were employed to locate reptiles: area-constrained hand-searching (HS) beneath logs, rocks and other habitat components in a defined search area (Osborne *et al.*, 1991); and pitfall trapping (PT) (Williams and Kukolic, 1991). Hand searching was usually carried out in the cooler months when the ground was moist and reptiles were relatively inactive in their winter hibernation sites. In contrast, pitfall trapping was conducted during the warmer months between November and March.

Each pitfall trapping arrangement included 20 pit buckets and four 25m lengths of nylon mesh drift fence set in a cross shape linked at the middle. Each arm of the array contained five metal ice-cream containers (11 litre) buried flush with the ground surface beneath the drift fence. Trapping at each site initially was conducted for six consecutive weeks. At sites where *T.l. pinguicolla* or *Delma impar* were captured trapping was extended throughout the remaining summer months (approximately 20 weeks). The details of the 32 sites trapped and the duration of each trapping period will be reported elsewhere.

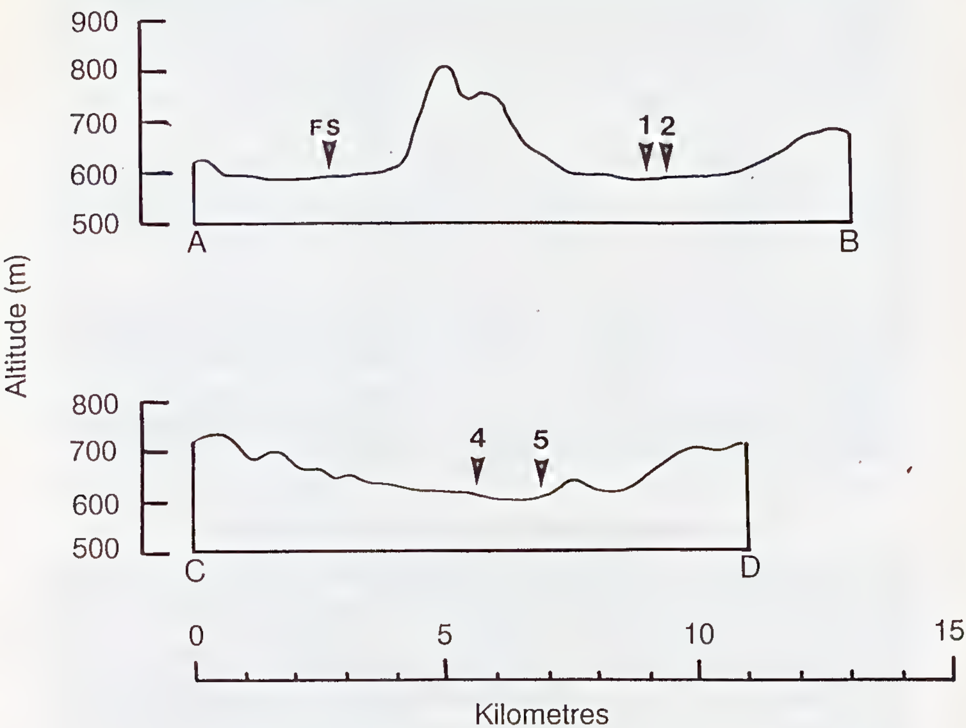
All individuals captured were measured (snout-vent length and tail length) and weighed. Adults were recorded as males if they had well developed breeding colours (bright yellow markings in the gular region and a pink suffusion on the sides of the body) and preanal pores. Other morphometric measurements were taken and will be reported at a later stage.

A soil profile was examined at each site and the underlying geology was determined from the 1:50,000 geology map (Bureau of Mineral Resources, Geology and Geophysics 1980). Vegetation structure and floristics were assessed within a one metre radius of the capture site of each individual. All plant species were recorded and their percentage cover assessed into five categories based on projected foliage cover: <20%, 20 - 39, 40 - 59, 60 - 79, 80 - 100%. In order to determine the full complement of plant species present all sites were visited twice; once in late December, 1991 and once in April, 1992. For each successful trap or capture site a complete species list which included estimates of foliage cover was prepared (not presented here, available from M.S. Davis).

RESULTS

Specimens of *T.l.pinguicolla* were captured at three locations near Canberra (Figs 1 and 2). Individuals were captured in pitfall traps at two locations (four trapping sites) in the ACT (Tables 1 and 2; Fig. 1). The first ACT location (Sites 1 and 2) was in an ungrazed paddock which enclosed an aircraft navigation facility north of Canberra Airport. The second location (Sites 3 and 4) was on the "Woden" pastoral property approximately 15km south-east of Canberra. In NSW, a single female earless dragon was found beneath a partially buried stone in a paddock on "The Poplars" grazing property 5km south-west of Queanbeyan (Site 5). Capture details and habitat descriptions for all five sites are given below. A more detailed description of these sites is available from the authors.

Figure 2. Topographic profiles showing positions of *T.l. pinguicolla* sites. The positions of transects A-B and C-D are indicated on Fig. 1. FS = former site with the species.



Location 1: Canberra Airport (Sites 1 and 2)

In November, 1991 two pitfall trapping arrays were established in an ungrazed fenced paddock enclosing a navigational facility immediately to the north of Canberra Airport. The vegetation in the paddock consisted mainly of native grassland (*Themeda triandra - Danthonia carphoides - Stipa bigeniculata* tussock grassland) which had not been grazed for over 30 years. Part of the site surrounding the navigation facility and access road is mown each summer to reduce fire risk. The mown area was not surveyed. Instead the trap arrays were established in native grassland within the area that was not mown.

The first site (Site 1) occurred on flat low-lying ground about 40m from a slight rise, and is situated near the junction between Quaternary alluvium and Middle Silurian volcanics which outcrop to the east of the site. Site 2 was located on the side of the slight rise approximately 100m east of Site 1, and about a metre higher in elevation. The soils at both sites were quite deep and comprised part of the Turner soil landscape association (Sleeman and Walker, 1979). Soils in this area occur in valley bottom situations and include yellow earths, red podzolics, yellow podzolics and solodics. At the trap locations where *Tympanocryptis* were captured the soils consisted of brown clay loams extending to more than 50cm in depth. Clay content in the soil profiles examined increased slightly with depth, but the soil within the profiles appeared to be well drained (F. Ingwersen, pers. comm.). There were few rocks and no soil cracks present at the sites, although some *Lycopsid* spider burrows were observed.

Site 1 was established in an area which included a substantial and well developed sward of *Themeda triandra* (kangaroo grass) (approximately 50% of the site; sward height between 30-40cm), and more open areas dominated by much shorter tussocks of *Danthonia carphoides* (wallaby grass) (sward height approximately 10-20cm) and some *Stipa bigeniculata* (tall speargrass). The patches not dominated by *Themeda* were clearly delineated from the *Themeda* patches, with little integradation of the two grassland types (Fig. 3). Species diversity was low in the *Themeda* grassland but quite high in the *Danthonia* grassland, with the main genera present being *Plantago, Eryngium, Centaurium, Bothriochloa,* and *Poa.*

Site 2 was located just to the east of Site 1 on slightly higher ground. The site contained several deeply embedded small boulders, but there was little bare ground, except where soil had been disturbed during trap construction. Vegetation at Site 2 consisted of mixed *Stipa bigeniculata* and *Danthonia* spp tussock grassland. Species diversity in this site was high with other common genera including *Eryngium, Vulpia, Asperula, Briza, Petoraghia,* and *Convolvulus.*

During 25 weeks of trapping, a total of five adult and six juvenile *T.l. pinguicolla* were captured at Site 1 along with many specimens of *Delma impar.* Most captures (73%) of *Tympanocryptis* were made in the more open areas where the ground cover consisted predominantly of *Danthonia* (Fig. 3). Several captures were also made in the *Themeda* dominated sections of the trap array, although these generally were within a metre or so of the edge of the patch of *Themeda.* Other plant species that were common near the successful trap locations were *Stipa bigeniculata, Eryngium ovinum, Trifolium* spp., *Asperula conferta* and *Plantago varia.*

Table 1. Geographic description of sites where *T.l. pinguicolla* were found near Canberra.

SITE NO.	SITE NAME	ALTITUDE	ASPECT	SLOPE & TOPOGRAPHY	GEOLOGY & SOIL	VEGETATION
1	Canberra Airport	570	flat	broad valley broad clay-loam	Quaternary alluvium no surface rocks	*Themeda-Danthonia-Stipa* tussock grassland
2	Canberra Airport	572	gentle (<5°) NW	broad valley	Silurian volcanics brown clay-loam, a few surface rocks	*Stipa-Danthonia* tussock grassland
3	"Woden" (north)	590	flat	floor of broad valley	Silurian volcanics brown sandy clay-loam, no surface rocks	Dense *Stipa* tussock grassland
4	"Woden" (south)	590	gentle (<10°)NE	lower edge of footslope at edge of broad valley	Silurian volcanics brown sandy clay-loam, a few surface rocks	Modified *Stipa-Bothriochloa* tussock grassland and exotic pasture species
5	"The Poplars"	590	gentle (<10°)NW	lower edge of footslope at edge of broad valley	Silurian volcanics brown sandy clay-loam, scattered surface rocks	*Stipa-Danthonia* tussock grassland

Table 2. Numbers of adult and juvenile *T.l. pinguicolla* captured at each site.

SITE	NO. OF WEEKS TRAPS OPEN	NO. OF INDIVIDUALS CAPTURED IN PITFALL TRAPS		NO. OF INDIVIDUALS FOUND DURING HAND SEARCHES	
		ADULTS	JUVENILES	ADULTS	JUVENILES
1	20	5	6		
2	20	1	1		
3	19	2	1		
4	19	1	1	6[a]	
5	not trapped			1	

[a] Found beneath stones at the foot of a low rocky knoll adjacent to the trap site.

Only two *Tympanocryptis* were captured at Site 2. The first individual was captured after 12 weeks of trapping. Several *D. impar* also were recorded at this site. The vegetation within a two metre radius of the trap location was dominated by grasses, particularly *Danthonia carphoides* and *Stipa bigeniculata. Eryngium ovinum* and *Helichrysum apiculatum* also occurred near the successful pitfall traps.

Location 2: "Woden" Property (Sites 3 and 4)

Five *T.l. pinguicolla* were captured on the "Woden" property. Three specimens were captured in pitfall traps at Site 3 and two individuals were captured at Site 4. On 26 September, 1992 a further six adults were found under large, partially buried boulders at the foot of a hillslope immediately west of the trapping area. One specimen was found under a piece of tin, one was sheltering under a loose stone and the rest were in burrows beneath the stones. The burrows may have been constructed by arthropods as they did not contain excavated soil at the burrow entrance. Although the two sites where *Tympanocryptis* were found had been grazed by sheep for well over one hundred years, this part of the property has had little cultivation or pasture improvement (C. Campbell, pers. comm.). The result is that both Sites 3 and 4 (see below) have a substantial component of native grasses present.

Site 3 was situated on gently sloping ground on the edge of the Jerrabomberra valley plain (Fig. 2). The area is underlain by late Silurian rhyodacite, and the soils are of the Florey soil-landscape association (Sleeman and Walker, 1979). The association includes mainly podzolic soils and soloths on gently sloping terrain. The soil at this site was deep and occurred over late Silurian rhyodacite. The surface soil in the profile examined consisted of brown sandy-clay loam grading to brown clay loam. Below 30cm the clay content increased, and the profile below 40cm consisted largely of reddish or yellow clay.

The vegetation cover at Site 3 consisted of dense *S. bigeniculata* tussock grassland. This grassland type is quite extensive at this location, extending as a dense sward for several hundred metres west of the site. At the time of capture the tussocks had died back leaving extensive mats of dead and partially flattened swards. Apart from *S. bigeniculata*, other common plants on the site included *Danthonia caespitosa, Oxalis* sp., *Trifolium* sp. and dense patches of exotic grasses *Vulpia* spp. and *Bromus* sp.

Site 4 was located about 800m south of Site 3 on a gently inclined footslope about 50m from a nearby rocky knoll on the eastern slope of a large hill (Fig. 2). The soil was brown in colour and moderately shallow, consisting of sandy clay-loam which graded into grey-brown clay loam,

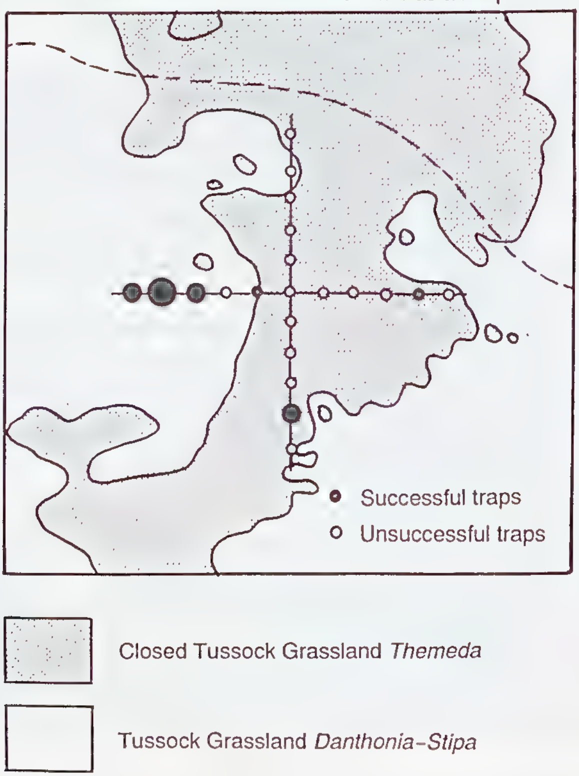
with rock fragments and gravel becoming common in the profile below about 20cm. The soil was free-draining but appeared to be harder-packed than at the airport sites, perhaps reflecting a higher clay content or compaction from livestock grazing (F. Ingwersen, pers. comm.). There were no soil cracks present at the site.

The most common grasses at Site 4 were *Bothriochloa macra, Stipa bigeniculata, Panicum effusum,* and the introduced *Vulpia bromoides*. The thistle *Carthamus lanatus* was abundant at this site, indicating a greater degree of disturbance than at the other *Tympanocryptis* sites.

Location 3: "The Poplars" (Site 5)

"The Poplars" site (Site 5) was located at 590m altitude on a broad footslope approximately 200m west of a rocky hill top, and about 20m up slope from the edge of a broad flat plain (Fig. 2). The site is underlain by Late Silurian rhyolitre, and partially-buried and weathered fragments of this rock type were scattered across the surface of the site, comprising about 10% of the ground cover. The specimen was found hibernating at the end of a short burrow (20cm) beneath a small, loosely imbedded, rhyodacite boulder. A soil profile was not examined at this site but the location is part of the same Florey soil-landscape association as occurs on "Woden" property (Sleeman and Walker, 1979).

Figure 3. Pitfall trapping arrangement in relation to grassland type at Site 1 near the Canberra Airport. Numbers of captured individuals are indicated as follows:
small closed circle - one individual captured;
medium closed circle - two individuals; large closed circle - three individuals.
The area above the dashed line is mown each summer as a fire prevention measure.



Vegetation at "The Poplars" site consisted of open *Stipa bigeniculata* tussock grassland. The main grasses occurring within a two metre radius of the capture site were *S. bigeniculata, S. falcata, Poa sieberana, Bothriochloa macra, Aristida ramosa* and *Aira* sp. Other species present near the capture site included *Helipterum australe, Trifolium subterraneum* (sub-clover), *Lomandra* sp. and *Vittadinia* sp. Several introduced Hawthorn bushes and rose briars occurred nearby. Although there were several well-used sheep trails through the grassland, the vegetation was comprised of predominantly native species. The paddock has been used mainly for sheep grazing and pasture management has not included application of fertiliser or cultivation (D. Larcombe, pers. comm.). The summit of the nearby hill is in a less natural condition, being dominated by exotic grasses and weeds from nutrient increase as a result of these areas being used as sheep camps.

DISCUSSION

Greer (1989), in reviewing information on the biology of the *Tympanocryptis* group, indicated that little is known of their ecology. Published information on their habitat preferences is particularly scant. Most texts refer to the *T. lineata* group as occurring on generally hard-packed or stony substrates in the interior of the continent (e.g. Houston, 1978; Wilson and Knowles, 1988; Greer, 1989). Habitats occupied include sparsely vegetated gibber plains, chenopod and *Acacia* shrublands, hummock grasslands, cracking black soil plains and sandy to rocky mallee scrub (Wilson and Knowles, 1988). The five sites where *T.l. pinguicolla* were found in the present study have two important features in common: all occur in naturally treeless areas, and all still support a perennial tussock grass cover which consists predominantly of native species. This indicates that the subspecies may be a true inhabitant of native grasslands.

It is not possible yet to describe the habitat components which are utilised by the lizards. However, we have provided a detailed description of the soils and vegetation of the sites which can be used as a reference for further work. The results indicate that tall dense grass swards completely dominated by *Themeda triandra* or *Stipa bigeniculata* may be avoided, although the lizards apparently can occur around the edges of such areas. There is an indication that the habitats preferred by the lizards are slightly open and include a significant component of shorter tussocks of *Danthonia* spp. as well as a substantial, but not complete, cover of the taller tussock *S. bigeniculata* which usually supports a dense basal thatch of dead grass stems.

Favoured microhabitats of *T. lineata* in other parts of Australia include elevated perching sites such as stones, fallen timber and ground that is higher than surrounding areas; and. for shelter, most forms of surface cover or cracks in the soil (Wilson and Knowles, 1988; Greer, 1989; Swan, 1990). In referring to the eastern tableland populations of *T. lineata*, Jenkins and Bartell (1980) state that in winter individuals have been found under rocks in a shallow depression, and that several individuals have been found utilising abandoned spider burrows. In the Melbourne region *T.l. pinguicolla* have been found sheltering under basalt stones (McCoy, 1889; Robson, 1968) and retreating into spider burrows (McCoy, 1889). Although rocks may be utilised for shelter there is no indication that they are essential habitat components in the Canberra region. At the site with the highest numbers of captures of the lizards (Site 1) there were no rocks present anywhere near the site. Rocks also were absent at one other ACT site.

It is not known if the lizards normally use burrows as homesites. Specimens that we have maintained in terraria sheltered deep in the basal stems and grass litter of tussocks, above ground level, or hid in the soil beneath loose tussocks, bark and stones. Further research will be needed to identify the homesites and oviposition sites of *T.l. pinguicolla*, particularly if the impact of grassland fires, and other disturbance, on the populations is to be considered.

Habitat Conservation

There has been considerable concern about the conservation of native grassland communities in south-eastern Australia (Stuwe, 1986; Frawley, 1991; McDougall and Kirkpatrick, 1993). The

native grassland habitats occupied by the lizards in the Canberra region are now fragmented, being small in extent, and isolated by roads, intensive agriculture and urban development. These sites are considered to be highly threatened because of their limited extent and close proximity to Canberra (Williams and Kukolic, 1991).

Possible impacts on the *Tympanocryptis* sites include (1) changes in land use such as urban development or an extension of the Canberra Airport; (2) an increased likelihood of fire; (3) invasion of the native grasslands by exotic plants; (4) pasture improvement such as cultivation or application of fertiliser; and (5) increased intensity of livestock grazing. In some cases the management of these remnants may involve a change in land use to secure the sites for conservation purposes. In addition, there will have to be site specific guidelines for the control of livestock grazing, weed invasion and prevention of fires.

The rediscovery of *T.l. pinguicolla* in the Canberra district highlights the need to conduct herpetofaunal surveys on other relict patches of lowland native grassland in the Southern Tablelands region.

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REPTILES AND AMPHIBIANS IN SCLEROPHYLL FOREST SURROUNDING OLD CHUM DAM IN NORTH-EASTERN TASMANIA

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ABSTRACT

A pre-logging survey of amphibians and reptiles was carried out over 13 months in a 500 ha area of sclerophyll forest surrounding Old Chum Dam in north-eastern Tasmania. *Ranidella tasmaniensis* was the most abundant frog species and can be considered to characterise the forest streams of the site. Three other species of frog were found around the dam. Ten reptile species, including a snake *(Notechis ater)* were found. However, only single specimens of three of the lizard species were found and another three species were very uncommon or restricted in their occurrence. Three skinks *(Niveoscincus occellatus, N.pretiosus* and *N.metallicus)* were common on the site. The uniformity of the canopy and the lack of low dense vegetation such as tussock grasses is probably limiting the diversity of reptiles on the site. The likely effects of logging on the herpetofauna are discussed.

INTRODUCTION

Surveys of birds and mammals are regularly undertaken in Tasmania. However, surveys of reptiles and amphibians are far less often reported. In this paper we report on a survey of the herpetofauna in an area of a sclerophyll forest of approximately 500 ha in north-east Tasmania. This study was undertaken in order to document the species present and their habitat preferences before the area was logged. Further studies will be undertaken after logging when the value of retaining unlogged strips of forest will be assessed.

STUDY AREA

The study was undertaken in north-east Tasmania on the south-east facing slopes to the north of Old Chum Dam (41°06', 148°03') and in forest south-west of the dam (Fig. 1). The main

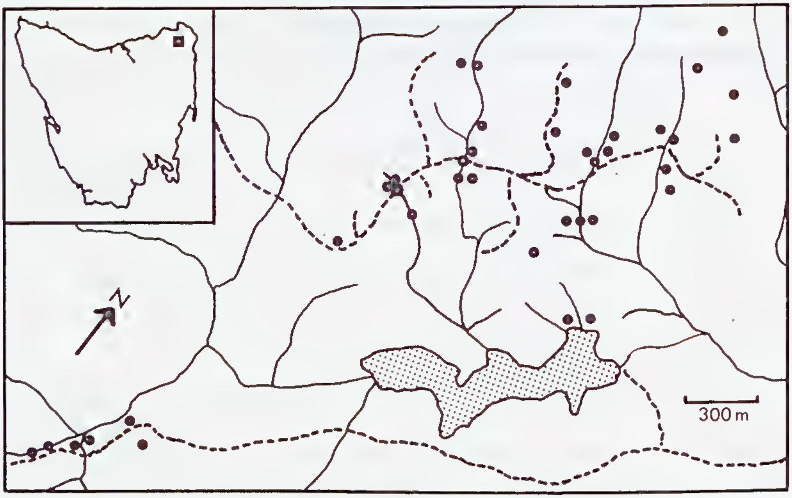


Figure 1. Location of the study area (insert) and the pitfall grids. Each circle represents a set of five (small pits, solid circles) or six (large pits, open circles) pits. The stippled area is Old Chum Dam. Dotted lines represent roads and solid lines represent streams or drainage lines.

eucalypt present is *Eucalyptus obliqua. E.amygdalina* is subdominant over much of the area and dominant in some flatter drainage lines. *E.viminalis* is widespread but uncommon. Understorey on most upper and middle slopes is very open being dominated by bracken *Pteridium esculentum.* The undergrowth is shrubbier on slopes above creek lines and gullies with *Acacia verticillata, Olearia lirata* and *A.terminalis* being most common. Vegetation along creeklines is of two major types. Blackwood *(Acacia melanoxylon)* forest occurs along steep gullies and in some well drained stream flats. *Atherosperma moschatum* is present in some of these sites. *Dicksonia antarctica, Olearia argophylla, Pomaderris apetala, Coprosma quadrifida* and *Bursaria spinosa* form a dense medium to tall shrub layer. The second type has an undergrowth dominated by dense myrtaceous tea tree scrub consisting of *Melaleuca squarrosa* and *Leptospermum scoparium* and is associated with basins and soakages with impeded drainage. Geology of the area is Ordovician granite. Rocky areas are common and several large outcrops with exfoliating rock are present.

METHODS

Two broad methodologies were utilised, pitfall trapping and direct observation (i.e. searching or listening to calls). Two types of pitfalls were used. The first were either plastic buckets or ice cream containers (diameter of 25 cm). Six of these were situated at each of two locations where a road ran through gullies containing dense tea tree. Each set of six pits was linked by a 30 m long nylon-mesh fence on the edge of the road and parallel to it. Herpetofauna would have been susceptible to being trapped if they emerged from the vegetation or creek and crossed or moved along the road edge. These two sets of pits were opened for a total of 55 nights each on the following dates: 17-18 June; 13-16 July; 18-20 August; 20-21, 23, 27-28 September; 11, 13-14, 21-29 October; 19-25 November; 15-19 December 1989; 19-23 January; 23-27 February; 22, 24-26 March and 17-19 May 1990. A second type of pit was set primarily to sample invertebrate populations but also captured reptiles and amphibians. These pits consisted of a small container inserted into a PVC tube (diameter 9 cm). A set of five of these pits was placed in two lines, one of three and another of two with a spacing of 8-10 m between pits. Thirty-six sets were distributed across the study area sampling the range of vegetation types present. These traps were set for seven days in each month from June 1989 to May 1990. Samples were also collected over the interval between these seven day periods in the June/July and July/August periods. The pits were sometimes interfered with by animals or were pushed up by ground water and no samples obtained from them during a particular month.

Searches along the shore of a small section of the northern side of Old Chum Dam near the overflow canal were made for frogs on the night of 11-12 October 1989. A period of 44 hours was spent searching for herpetofauna (by A.D.) in the area north of the dam from 15-25 January 1990 with all vegetation types being sampled. The survey technique varied with the prevailing weather conditions. During mild, sunny and still conditions non-destructive surveys were carried out on foot. This involved walking through respective habitats and surveying possible basking sites with the aid of 9 x 20 binoculars. This allowed the identification of basking reptiles from a distance of eight metres. Because of limited visibility surveying gullies where dense vegetation occurred was more difficult. Here more time was spent stationary, scanning potential microhabitats from close range. Generally reptiles present would emerge within five minutes of cessation of disturbance. The sit and wait method was also used in warm to hot weather, when most reptiles appeared exceptionally timid. During cold and overcast conditions reptiles were located by turning over rocks, logs, log fragments and bark and raking through leaf litter. This method was strongly biased against *N.pretiosus* which, although abundant on the area, tended to utilise deep crevices in logs for shelter and was thus inaccessible. During the January searches amphibians were found by turning over debris by the dam and around creeks. Excursions were made on a number of evenings to locate frogs by their calls but on the whole the frogs were silent. A number were heard calling from gullies but these were exceptional.

RESULTS
Amphibians

Litoria ewingi **Brown tree frog**

Several individuals were found around the dam margin and one was found in a bucket pitfall in the tea tree gully in September. This species is unlikely to be common as the area is relatively well drained.

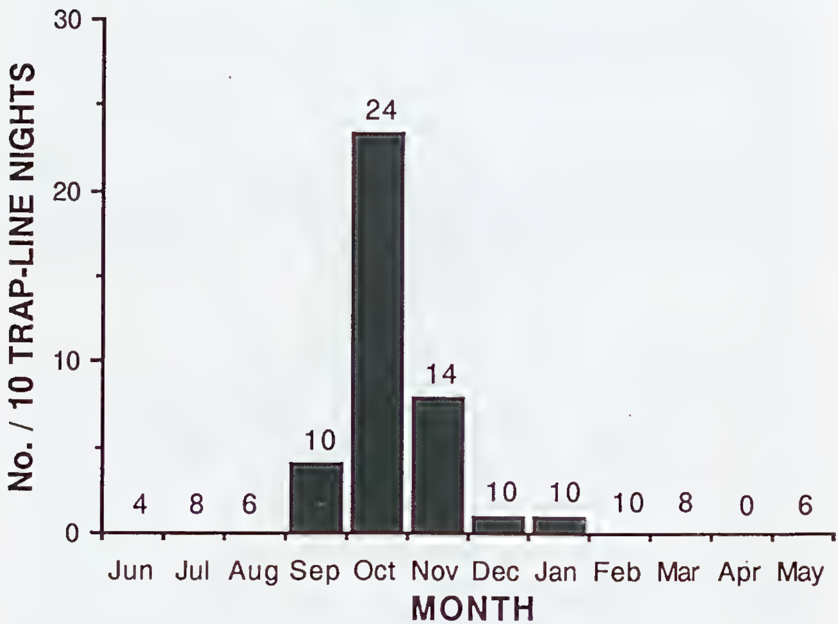
Limnodynastes tasmaniensis **Spotted grass frog**

One individual was found on the margins of the dam in October. This species tends to be more common in open forests and cleared or disturbed areas.

Ranidella tasmaniensis **Tasmanian froglet**

This species is the most abundant frog on the study area. Specimens were collected and calls were recorded from both blackwood and tea tree gullies and around the dam perimeter. A total of six individuals were caught in the small pit traps in or close to tea tree or blackwood gullies between July and March. The 55 individuals caught in the large pit traps on the road through the tea tree gullies were mostly caught in spring when breeding occurs (Fig. 2).

Figure 2. Number of *Ranidella tasmaniensis* caught per 5 trap-line nights in large pitfall traps set on a road running through two tea tree gullies. The numbers above the bars are the number of trap-line nights. Total number captured was 55.



Ranidella signifera **Brown froglet**

This species was found under debris around the dam perimeter, although in lower numbers than *R.tasmaniensis.* This species favours open or disturbed areas, breeding in temporary or shallow ponds. This species is likely to be uncommon in the area and restricted to the vicinity of the dam.

Reptiles

Snakes

Notechis ater humphreysii Tiger Snake

A tiger snake was found in open bracken undergrowth in January 1989. A further three individuals were found during the surveys in January 1990, two on the edge of tea tree gullies and one in forest to the south-west of the dam. The species is likely to forage through a variety of habitats on the study area but occur at low densities due to a limited availability of prey (frogs and small mammals).

Lizards

A total of 54 lizards were caught in the small pitfalls between September and March. There were no significant differences between numbers caught in these months (Chi-square test). Three were caught in the large pits on the road through a tea tree gully between November and January. Table 1 lists captures for different vegetation types for the period September to March, along with numbers sighted during January.

Niveoscincus pretiosus Tasmanian tree skink

This species was the most commonly observed during active searching in January and was the second most commonly trapped skink (Table 1). All specimens observed were in close association with logs. Crevices in logs are the most used shelter site for this species. They were trapped most commonly in pitfalls in areas with dense bracken or shrubs. Observations indicated they were rare in blackwood gullies, but could occur in any area usually in association with fallen logs, particularly if the canopy had been opened up as a result. High densities occurred in association with log piles left beside the road.

Table 1. Numbers of lizards trapped in small pitfalls and observed around Old Chum Dam, north-eastern Tasmania. Numbers of trap nights listed are only those between September and March as no lizards were caught in the colder months.

SPECIES	Blackwood Gully		Tea Tree Gully		Dense Bracken and/or Shrubs		Open Bracken	
	Small Pits	Sightings	Small Pits	Sightings	Small Pits	Sightings	Small Pits	Sightings
N.pretiosus	2	2	-	5	12	47	-	21
N.ocellatus	-	-	-	-	-	-	2	65
N.metallicus	1	4	6	6	22	8	-	33
N.delicata	-	-	-	-	2	-	-	1
P.entrecasteauxii	-	-	-	-	-	-	-	-
B.duperreyi	-	-	-	-	-	-	1	-
E.whitii	-	-	5	-	-	-	-	7
T.diemensis	-	-	-	-	-	1	1	-
T.nigrolutea	-	-	-	-	-	-	-	-
No. of trap nights	203		239		431		246	

Niveoscincus ocellatus Spotted skink

This species was most often found in areas of open bracken. None was recorded in blackwood gullies. Most were found under log fragments but highest densities occurred in an area of exfoliating granite, probably due to the secure sheltering habitat this provided. The species appears not to be susceptible to pitfall traps as it was often sighted but rarely occurred in traps.

Niveoscincus metallicus Metallic skink

This species was often observed and individuals occurred across the full range of terrestrial habitats, but with the majority being associated with dense bracken. This species is normally associated with logs, but makes use of those in a far more advanced state of decomposition than other species. It also basks and shelters in deep litter around the base of eucalypts.

Lampropholis delicata Delicate grass skink

No specimens were observed during searching in January. However, one individual was seen in bracken with some short tea tree near the outlet of the dam in November 1991 (R. Brereton, personal communication). Two individuals were caught in small pitfalls both in dense bracken areas, one north and the other south of the dam. The species requires developed litter for foraging and is usually associated with a medium density undergrowth (Rawlinson 1974). It appears to be widespread but uncommon in the area.

Pseudemoia entrecasteauxii Grass skink

Only one specimen was found. The species is normally associated with more open habitats with dense ground cover, such as open woodland or heathland (Rawlinson 1974, Hutchinson and Donnellan 1992). The closest suitable habitat of this form is a buttongrass *(Gymnoschoenus sphaerocephalus)* moorland over a kilometre from the capture site. However, in forested areas activity can be centred around fallen logs. It is perhaps significant that the specimen was in the large pitfalls on the road where sunlight penetration was improved and log piles were present nearby.

Bassiana duperreyi Three-lined skink

One juvenile was found in a pitfall trap in open bracken nearby the dam. The species is normally associated with areas containing a low ground cover of tussock grasses or heath-like vegetation (Rawlinson 1974).

Egernia whitii White's skink

A small localised population of this species occurs north of the dam in an area of a granite extrusion where exfoliating slabs provide a suitable microhabitat. The soil overlying this outcrop is too shallow to support eucalypts and is dominated by *Allocasuarina littoralis* and *Bursaria spinosa*. This open vegetation is typical habitat for the species but is limited in the north of the study site to this area of granite outcropping. Five individuals were caught in pit traps just inside a tea tree gully south of the dam. The slope above this gully was a dry site with sandy soil and *A.littoralis* present.

Tympanocryptis diemensis Mountain dragon

An individual was found in a small pit trap in open bracken south-west of the dam. Another individual was observed at the edge of a road through dense bracken. Good sunlight penetration at this point was afforded by the presence of the road. A number of subsequent searches at this roadside location failed to reveal further sightings. The forests in the area are generally not open enough for this species and only a low density population is likely.

Tiliqua nigrolutea Blotched bluetongue

The only record for this species is a juvenile found in a large pit trap. Bluetongues normally prefer more open woodlands than present in the study area.

DISCUSSION

A total of four of the eight amphibian species whose distributions include inland north-eastern Tasmania were found on the study area. *R.tasmaniensis* was by far the most numerous species and can be considered to be the frog characterising the small forest streams in the area. During active searching in January weather conditions were not conducive to amphibian activity and little searching was done at other times. Thus further species may be found with more thorough searching. Two *(L.raniformis* and *Pseudophryne semimarmorata)* of the four species that were not found but whose distributions include north-eastern Tasmania are unlikely to occur due to

lack of suitable habitat. The other two *Geocrinia laevis* and *L.dumerili* could be present around the dam margins as both these species breed on the margin of permanent water bodies. G. Lohrey, one of the forestry workers logging the site, reported hearing an unusual frog call coming from a tea tree gully in February 1993. When played a tape of the calls of Tasmanian frogs he concluded it was *L.dumerili.*

Ten of the 13 species of reptiles occurring in north-east Tasmania were found on the study area. However, three of these ten *(P.entrecasteauxii, T.nigrolutea* and *B.duperreyi)* were represented by a single individual and are unlikely to have a population resident on the site. Another three species *(L.delicata, T.diemensis* and *E.whitii)* were either very uncommon or restricted in their distribution. The absence or low abundance of reptile species in the area can be explained by their habitat or thermoregulatory requirements. Most of these relate to the absence of open woodlands with good penetration of sunlight and the absence of low-dense vegetation such as tussock grasses. Many of these missing or low abundance species also occur on mainland Australia but within Tasmania they are restricted to the north and east of the state. The dominant species on the site *(N.pretiosus, N.ocellatus* and *N.metallicus)* are all widely distributed across the state, either geographically and/or altitudinally.

Based on the habitat requirements of the species it is possible to speculate on the effects of logging of the study site. *R.tasmaniensis*, the most abundant frog, is unlikely to be adversely affected as all the streams in the area have a protective buffer maintained along them. Numbers of *R.signifera* and *L.tasmaniensis* may increase as they favour disturbed or open areas and breed in temporary as well as permanent ponds. Such situations are likely to be created by disturbance associated with logging. The other frogs associated with the dam are unlikely to be affected as wide buffers will be maintained around the dam. Of the three abundant skinks in the area, *N.ocellatus* is likely to decline after logging as the denser undergrowth created by the regeneration will not favour this species due to its preference for open vegetation. Such effects on skinks with similar requirements to that of *N.ocellatus* have been documented in both Victoria (Brown and Nelson 1992) and New South Wales (Lunney *et al.* 1991). *N.pretiosus* may also decline somewhat overall but its high densities associated with log piles along roads indicates it may be able to maintain good populations in these artificially-produced sunlight gaps. *N.metallicus* was found to favour a denser canopy. It thus may suffer a short-term decline after logging but should re-establish high densities in the regrowth.

ACKNOWLEDGMENTS

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NOTES ON FEEDING INTERACTIONS IN AUSTRALIAN REPTILES

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INTRODUCTION

Feeding interactions by reptiles may be the result of:

Two reptiles (usually snakes) attempting to eat the same food item with one reptile also eating the other attached reptile. This type of accidental predation is commonly observed and documented for captive snakes.

Severe hunger confinement or some other stressful situation causing a reptile to depart from normal behaviour and eat another. This may be a smaller member of the same species or another species.

Normal behaviour in the feeding on other members of the same species, which is demonstrated in both wild and captive animals.

Cannibalistic behaviour has been reported in a number of Australian reptiles. Specific cases and species previously documented include:

Sand Goanna *Varanus gouldii*, Johnson (1976)
Black-headed Python *Aspidites melanocephalus*, McPhee (1979)
Spotted Python *Liasis maculosus*, Maguire (1990)
Desert Death Adder *Acanthophis pyrrhus*, Fyfe and Munday (1998)
Gow (1981), Hoser (1989)
Highland Copperhead *Austrelaps ramsayi*, Jenkins and Bartell (1980)
Copperhead *Austrelaps* sp., Gow, (1982, 1983, 1989), McPhee (1979),
Shine (1977)
Small-eyed Snake *Cryptophis nigrescens*, McPhee (1979)
Swamp Snake *Hemiaspis signata*, McPhee (1979)
Tiger Snake *Notechis scutatus*, McPhee (1979)
Black Tiger Snake *Notechis ater*, Gow (1983, 1989)
King Island Tiger Snake *Notechis ater humphreysi*, Worrell (1970)
King Brown Snake *Pseudechis australis*, Gow (1982, 1983, 1989), McPhee (1979)
Blue-bellied Black Snake *Pseudechis guttatus*, McPhee (1979)
Eastern Brown Snake *Pseudonaja textilis*, McPhee (1979)
Myall Snake *Suta suta*, McPhee (1979)
Little Whip Snake *Unechis flagellum*, Turner (1987)
Gould's Snake *Unechis gouldii*, Shine (1977)

Cases of cannibalistic and similar feeding behaviour is documented here for the Lace Monitor *Varanus varius*; Desert Death Adder *Acanthophis pyrrhus*; Swamp Snake *Hemiaspis signata*; Yellow-faced Whip Snake *Demansia psammophis*; Red-bellied Black Snake *Pseudechis porphyriacus*.

OBSERVATIONS

Lace Monitor *Varanus varius*

During the period 1975-83, I held seven adult Lace Monitors *Varanus varius* in two interconnected outdoor pits some 15 metres long and 6 metres wide in near natural conditions in a Sydney suburb (Hoser, 1989. p.182).

On separate occasions, at least five adult Blue-tongued Lizards *Tiliqua scincoides* and two adult Eastern Water Dragons *Physignathus lesueurii* were placed inside the pit and were immediately eaten (swallowed whole) by one of the dominant male *V. varius.*

During January 1978, two sand monitors *Varanus gouldii* both measuring in excess of 1000mm total length were housed with the *V. varius.* A single 1500mm Heath Monitor *V. rosenbergi* had been kept with the *V. varius* for some years without incident.

About two weeks following the introduction of the two *V. gouldii* into the pit one of the male *V. varius* was found with the tail of the smaller *V. gouldii* protruding from its mouth. It was forced to regurgitate the *V. gouldii,* which was dead. The male *V. varius* measured 1760mm in total length. Neither it nor any other monitor in the cage was underfed although all were kept hungry (in warmer months), unlike some captive *V. varius* which tend to become excessively obese.

The second, larger *Varanus gouldii* was left in the cage with the *V. varius* as its substantially larger bulk would, it was thought make it more compatible with the *V. varius*

A week later the same male *V. varius* was found with the second *V. gouldii* protruding from its mouth. The *V. varius* had only managed to swallow the anterior half of the body. It was again forced to regurgitate the *V. gouldii* which was already dead.

On at least two occasions in the pit, a female *V. varius* excavated a hole and deposited eggs. These eggs were dug up and eaten by one or more monitors in the pit. On one occasion, only *V. varius* were resident in the pit.

Desert Death Adder *Acanthophis pyrrhus*

During the period 1976-84, I held a number of Death Adders *Acanthophis antarcticus,* Desert Death Adders *A. pyrrhus* and Northern Death Adders *A. praelongus.* All were kept indoors in glass cages with an average of 2 snakes per cage, although these numbers varied as the snakes were moved between identical cages. On some occasions, different species were caged together, virtually always without incident.

On two separate occasions an adult male *A.pyrrhus* was found to have eaten a cage cohabitant of the same species and sex. The eaten snakes were subsequently found regurgitated and dead. No food had been in the cages at the times of the incidents and neither snake was in a state of undue leaness.

On another occasion an adult (approx. 550mm) male *A. pyrrhus* ate a female *A. antarcticus* (approx. 320mm) that was in the same cage. The snake was subsequently regurgitated in a largely undigested state.

No behaviour that could be construed as cannibalistic was ever observed in *A. antarcticus* or *A. praelongus.*

Yellow-faced Whip Snake *Demansia psammophis*

A large captive adult male *D. psammophis,* 1000mm in length, was observed feeding on a juvenile of the same species. At a later date, the same snake fed on a Green Tree Snake *(Dendrelaphis punctulata)* of similar length. Both incidents occurred in the spring of 1976 (Robert Croft, pers. comm.).

Swamp Snake *Hemiaspis signata*

In late spring 1976, one adult Swamp Snake *Hemiaspis signata,* one juvenile of the same species, estimated at about 9 months of age and two adult Copper-tailed Skinks *Ctenotus taeniolatus* were caught and placed in a single bag. Later the bag was opened and found to contain only the adult *H. signata.* Inspection of the snake revealed that it had fed on the three other reptiles placed in the same bag (Robert Croft, pers. comm.).

Red-bellied Black Snake *Pseudechis porphyriacus*

In 1973, I held a 1200m Red-bellied Black Snake *P. porphyriacus* and a 900mm Freshwater Snake *Tropidonophis mairii* in the same 1300mm cage. The Black Snake ate and later regurgitated the Freshwater Snake which failed to survive. Both snakes had been together in the cage for several months without incident and both were in good health feeding exclusively on frogs. No frogs were in the cage at the time of the incident.

DISCUSSION

The saurophagous nature of *V. varius* is well known and further documented here. The incidents detailed here indicate that *V. varius* is a potentially cannibalistic species. Smaller specimens certainly run the risk of being eaten by members of the same species.

To my knowledge, the only Australian varanid documented to date as being potentially cannibalistic is *Varanus gouldii* (Johnson 1976, Polis and Myers 1985).

That Desert Death Adders *Acanthophis pyrrhus* are apparently prone to cannibalism, while *A. antarcticus* and *A. praelongus* are not may have something to do with the dietary preferences of the three species.

Fyfe and Munday (1988) commented that newborn *A. pyrrhus* had to be separated after the first slough to prevent cannibalism. In natural conditions, neonates would be unlikely to come into contact with one another shortly after birth, consequently the risk of cannibalism would be slight. However captive conditions could be a catalyst for cannibalistic behaviour in young of the species. Gow (1981) also recorded cannibalism in this species.

D. psammophis aggregates and is commonly found in pairs (Hoser 1980, 1990). Cannibalism by this species in the wild would be unlikely and it would seem that the cases observed by Croft in 1976 were abnormal behaviour.

McPhee (1979), noted that Hemiaspis signata is "prone to cannibalism" and the circumstances in the case described here were such as to induce cannibalism.

Red-bellied Black Snakes *Pseudechis porphyriacus* aggregate for breeding purposes, (Hoser 1980, 1990). Therefore the case documented here could not be interpreted to imply that cannibalism is normal for this species. Worrell (1970), plate 59, shows a photo of this species consuming an eel, a long creature of similar form to a snake. It is possible and likely that *P. porphyriacus* will feed on suitably sized snakes of other species should the opportunity arise.

In relation to the Blue-bellied Black Snake *Pseudechis guttatus,* McPhee (1979), states "It is almost certainly cannibalistic." He also makes a similar comment for the Small-eyed Snake *Cryptophis nigrescens.* He quotes a large number of snakes as having cannibalistic tendencies including a species which Worrell (1970) makes a point of stressing is not cannibalistic, namely *Notechis scutatus.* Gow (1983, 1989) not does not note cannibalistic behaviour in *N. scutatus,* but does in *N. ater.* Worrell (1970) also documents cannibalism in *N. ater.*

I question some of the cannibalism records documented by McPhee (1959, 1979), although comments made by Polis and Myers (1985), stress that physically at least, most reptiles are capable of cannibalism.

Globally, Polis and Myers (1985) found reports of cannibalism and/or oophagy in over 100 species of reptile and amphibian. They concluded that "since few reptiles and amphibians are morphologically incapable of cannibalism, we expect the number of known cannibalistic species will increase as more research is completed."

Wilson (1975), noted the correlation between those species most studied as those most likely to have cases of intraspecific predation recorded or observed. Such is certainly true for Australian species. With more people keeping snakes in captivity it is not surprising that there

are more cases of cannibalism recorded for snakes than lizards, and relatively few cases of cannibalism recorded for Australian frogs.

Cases of alleged cannibalism in many species of snake or other reptile may be induced by captive conditions, and therefore may not really indicate the natural behaviour of the species in question.

ACKNOWLEDGMENTS

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HERPETOLOGICAL NOTES

AN OBSERVATION OF INSECTIVOROUS FEEDING HABITS IN THE GREEN TREE SNAKE *(DENDRELAPHIS PUNCTULATA)*

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During a recent visit to Carnarvon Gorge, central Queensland, a brief observation was made of an unusual feeding behaviour in the colubrid snake *Dendrelaphis punctulata*. At around 1100 hours on a warm sunny day (temperature approximately 28°C) in early March 1993, a green tree snake was seen amongst a clump of sedge grass approximately 1 metre from the river's edge. The snake appeared active and quite agitated, moving nervously in a short "start stop" motion while holding an object in its jaws.

On closer inspection the item was seen to be some type of flying insect as a pair of large, elliptical, transparent wings were projecting out of each side of the mouth. The wings were consistent with a dragon - or damsel-fly, a lace wing or a similar type of insect. The wings were seen to move up and down slightly, though this appeared to be a consequence of the snake making a chewing motion rather than movement from the insect. When approached closer the snake rapidly fled into the clump of sedge and disappeared.

Many early authors listed insects as prey items for Australian snakes (e.g. Kinghorn, 1929, Worrell, 1963, Gow, 1976). However, Shine (1991a) states that although insect fragments are often found in snake digestive tracts, in most cases these were secondarily ingested from a vertebrate prey item. He does indicate that occasional crickets have been found in some elapids and in his examination of Australian colubrids (Shine, 1991b) he lists 76 prey items from 58 *D. punctulata,* including one insect item, also a cricket. Considering the huge number of Australian snake stomach contents examined by Shine over the last 15 years the occurence of insects as prey items in Australian snakes (apart from typhlopids) is evidently a very rare event.

It is possible that the insect observed being eaten by the green tree snake had been captured by a frog or lizard which was then taken by the snake, both items being swallowed consecutively. It seems likely however; that the frog or lizard would have dropped the prey item when the snake struck. Even if this did occur, the insect may have become contaminated by the lizard or frog's scent (in the same fashion as keepers scent mice for lizard eating snakes) and the insect then eaten independently by the snake. The most parsimonious explanation, however, has to be that the snake captured and ate the insect itself, despite the rarity of such events in Australian snakes. Though the importance of invertebrates in most native snake diets is apparently negligible, this observation still raises some interesting questions regarding the causes of such behaviour.

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INTRASPECIFIC AGGRESSION IN WESTERN BROWN SNAKES *(PSEUDONAJA NUCHALIS)*

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Several of the larger species of Australian elapid snakes have been recorded exhibiting male combat bouts during the breeding season. This has been noted in Taipans *(Oxyuranus scutellatus)*, Red-bellied black snakes *(Pseudechis porphyriacus)*, Copperheads *(Austrelaps*

superbus), Black whip snakes *(Demansia atra)*, Tiger snakes *(Notechis scutatus)*, Eastern brown snakes *(Pseudonaja textilis)*, Swamp snakes *(Hemiaspis signata)*, White lipped snakes *(Drysdalia coronoides)* and Small eyed snakes *(Cryptophis nigrescens)* (Shine, 1991; Gow, 1989; Wilson and Knowles, 1988). It has been assumed that other members of these genera also exhibit the same type of combat behaviour.

The combat described is usually of the form where the snakes end up tightly "corkscrewed" around each other (Shine, 1991; pages 119 and 120 and Worrell, 1963; plate 59 for photos), each snake trying to hold the other's forebody to the ground. Biting is not reported in these bouts. These ritualised "dances" probably developed to prevent actual physical harm to the combatants - being more a test of strength. Biting would entail physical damage to both parties via the mechanical damage inflicted by the teeth to the victim and the possibility of damage to the teeth and jaws of the aggressor.

Captive Western brown snakes *(Pseudonaja nuchalis)* in my collection, which came from the Alice Springs area, have shown an interesting form of male combat. In mid September 1990 on introducing an extra adult male to an indoor cage (2m x 0.6m x 1m) containing 4 adult males and 1 adult female snake, all the male snakes showed great agitation, recklessly rushing about the cage for about 5 minutes. After this, 3 of the resident males began chasing each other and the newly arrived male. The speed of the chases varied but when they slowed or stopped if the aggressor was near the victim's body, it would grab hold of the victim with a savage bite and hold on (generally on the posterior 2/3rds of the body and tail). The victim would move away quickly with the aggressor attempting to hang on but usually having to release its grip whereupon the chase began again. In the confines of the cage the aggressors were often distracted by the movements of another snake and switched victims in mid chase, or became victims themselves as another snake became aggressive towards them.

After 3 days, 2 of the male snakes had many damaged scales on the posterior 1/3 of the body and tail. Venom was probably injected during the bites because the bitten area developed a "blistered" look (similar to mosquito bites in sensitive humans) which subsided over the following 12 hours.
After this fighting behaviour the female snake became gravid and laid 7 fertile eggs on 21 December 1990 but it is not known which male or males mated her to achieve fertilisation.

At no stage during these chases did the male snakes adopt the "corkscrew" postures familiar to the combat of other species. Captive *P.textilis* in similar sized cages have been observed to chase each other about, intertwining tightly to form the classic "corkscrew" posture with the head and forebody of each snake trying to rise above that of its opponent. Biting was not observed in these encounters (R. Burrell pers. comm., J. Scrivan pers. comm.).

During the spring of 1991, these same snakes in the same cage under the same seasonal and daily conditions, did show some aspects of the "typical" male combat of Australian elapids. The length of detailed observations in 1991 were much less (only 3 hours vs about 5 hours) than in 1990 but on 2 separate days 2 male snakes were seen to intertwine loosely and attempt to force each other's head downwards. Their heads often reached heights 25-30 cm above the substrate. This activity continued for up to half an hour at a time, each bout lasting for 1-2 minutes before the lower snake would break contact by fleeing, causing the upper snake to give chase. After about half an hour, this behaviour broke down and reverted to the biting fights observed in 1990.

In both 1990 and 1991 these events were intense for 2 to 3 days and all aggression ceased after about 7 days. The cue for the sudden onset of aggression between the male snakes in 1990 may have been the addition of the new male; but in 1991 there was no obvious causal stimulus.

It would appear that *P.nuchalis* possess a poorly developed ritualised male combat behaviour and that the species may resort to a primitive and physically hazardous method of overcoming

rivals. In a field situation, it is probable that a fleeing snake would be able to avoid its aggressor and that bites are rarely inflicted.

One possible explanation for the differences in male combat behaviours seen between *P.nuchalis* and *P.textilis* could be linked to the differences in density of the two species in their usual habitats. My impressions of *P.textilis* in Victoria indicate a higher density per hectare than I could ever hope to see in *P.nuchalis* around Alice Springs. Animals that have more frequent contact due to higher density are probably more likely to need and evolve a mechanism to reduce physical damage in encounters between sexually competing adults.

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TAIL REGENERATION IN THE MILITARY DRAGON, *CTENOPHORUS ISOLEPIS.*

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Regeneration of all or part of a tail after it has been removed is common in a number of lizard families. In Australia this includes most members of the families Scincidae, Geckonidae and Pygopodidae. Tail regeneration has so far only been reported in a few species of Australian agamid *(Amphibolurus temporalis, Ctenophorus caudicinctus, C.femoralis, C.ornatus, C.rubens, C.rufescens, Diporiphora bilineata* and *Physignathus lesueurii)* (Greer 1989). This note describes an observation of tail regeneration in another species of dragon lizard.

An adult male military dragon, *Ctenophorus isolepis*, was collected on Ethabuka Cattle Station (24°15'S 138°20'E), 150 kilometres west of Bedourie in southwest Queensland, on 30th September 1992. The specimen was taken during an ongoing research project on the ecology of desert fauna.

The distal 16 mm of the specimen's tail was regenerated. Externally, the regeneration was recognisable by its different scalation. The scales were approximately 50% smaller on the regenerated portion, than on the original tail.

Regenerated tails do not have vertebrae, but are supported by a central cartilaginous rod (Greer, 1989). The tail was dissected to confirm a lack of vertebrae. The distal 16 mm of the tail was supported by a central cartilaginous rod (approximately 1 mm in diameter), whereas the proximal portion was supported by a column of vertebrae. The regenerated portion was much less flexible than the rest of the tail.

Although only a small proportion of Australian agamid species have been reported to show tail regeneration, the phenomenon may be more widespread. Most agamids are fast moving diurnal species and may seldom suffer tail loss and so are unlikely to be observed with regenerated tails. In a sample of 213 *C.isolepis* for which morphological data were taken only 11 had unusually short tails, presumably due to tail loss, and of more than 300 specimens caught in this study, this is the first one observed with any obvious tail regeneration. With further observation, more species of Australian agamids may be found to regenerate their tails.

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OPHIOPHAGY IN THE COMMON BLACKSNAKE *PSEUDECHIS PORPHYRIACUS*

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Recently I caught a large adult blacksnake (approx. 1.5m total length) near Coree Flats in the Brindabella Ranges, south of Canberra. Whilst I was holding the animal it began to writhe violently and shortly thereafter it regurgitated the remains of a large copperhead *(Austrelaps ramsayi)* (Fig. 1). The regurgitated food item was approximately 75cm in length and although the anterior half had been digested, it was clear that it had been an adult animal.

Ophiophagy is not unknown in *Pseudechis porphyriacus.* Shine (1977, 1987) found three species of snake *(Ramphotyphlops nigrescens, Rhinoplocephalus nigrescens* and *Suta gouldii)* in the stomachs of blacksnakes caught in the New England area and three species *(Hemiaspis signata, Boiga irregularis* and *Pseudechis porphyriacus)* in the stomachs of museum specimens from New South Wales and Queensland. All of the species recorded were relatively small and/or thin bodied. I am unaware of any records of blacksnakes eating larger, more heavy bodied snakes such as copperheads, tigersnakes or brownsnakes, species with which they are often sympatric (e.g., Shine, 1977).

It is not uncommon for large snakes to consume each other in captivity, usually when two snakes attempt to consume the same food item (e.g., Gow, 1989). This, however, is clearly a result of the unnatural conditions of captivity and would be rare in the wild. Blacksnakes are essentially opportunistic feeders, preying on whatever vertebrates (or even the occasional invertebrate) they come across (Shine, 1977). The rarity of records of blacksnakes eating other large snakes is most likely a reflection of the low densities of large snakes and thus the reduced likelihood that they will come across each other when foraging. It is possible that the copperhead was dead when the blacksnake encountered it. A few other species of Australian snake have been observed to consume dead prey items (e.g., Bedford, 1991a,b).

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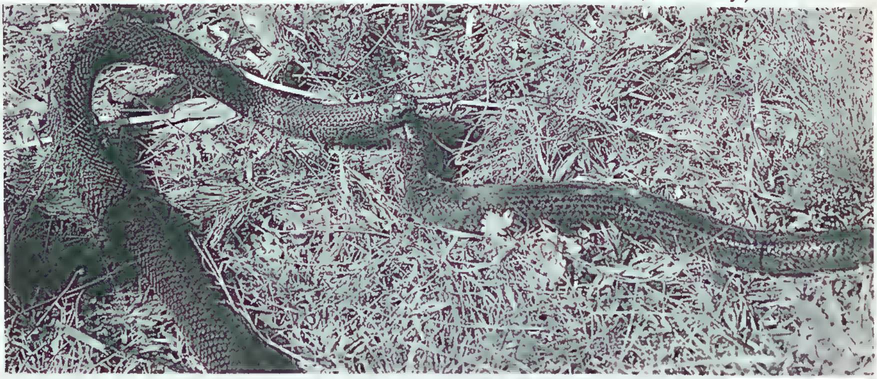
Figure 1. An adult common blacksnake *(Pseudechis porphyriacus)* regurgitating the remains of a large copperhead *(Austrelaps ramsayi).*



VOCALISATION IN *RAMPHOTYPHLOPS*?

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In December, 1983 while handling an apparently healthy juvenile female *Ramphotyphlops proximus* (total length 194mm) from Wagga Wagga, NSW (35° 16'S, 147° 41'E),I was somewhat surprised to hear it make a soft but distinct high pitched squeak. A similar sound was repeated on two further occasions while in captivity. The sound produced was not unlike that produced by the pygopodid *Delma inornata* (Annable, 1983) and the duration of each squeak was estimated at no more than 0.5 sec.

I have handled over fifty specimens of four different species of blind snake *(R. bituberculatus, R. nigrescens, R. proximus and R. wiedii)* but never observed such behaviour before. I made a note of the event thinking that it may have been just a freak event or just a high pitched wheeze (which I have heard in several skink species on rare occasions).

More recently I was prompted to re-examine the original observation when I heard a similar high pitched squeak coming from a specimen of *R. nigrescens* (adult female, total length 332mm, from Cooranbong, NSW [33° 04'S, 151° 27'E]). This specimen had just been captured apparently almost undamaged by a neighbour's cat.

It is impossible to say from these observations whether the sounds were controlled resonant vocalisations or whether they were just coincidental sounds produced perhaps by mucus or inflammation of the glottis area. Schwaner *et al.* (1985) quote unpublished field notes of F.J. Mitchell, that *R. australis* "emits an audible squeak when handled roughly" and that this sound was heard repeatedly "during attempts to photograph a specimen in daylight. 9.v.58". *Ramphotyphlops* species have a glottis controlled by voluntary muscle (pers. obs.) which presumably closes the glottis during swallowing and at other times. The above observations support the possibility that the neuronal circuitry to co-ordinate respiratory and glottis muscle activity required for controlled vocalisation is present in the genus *Ramphotyphlops* although further observations are still needed to confirm this conclusion.

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BOOK REVIEW
REPTILES AND AMPHIBIANS OF AUSTRALIA

by Harold G. Cogger. New edition. Fully illustrated.
Reed Books, Chatswood, NSW. 1992. 775pp. $89.95.
(The cost of the Cornell University Press, Ithaca, New York, printing, is US$97.00)

Hal Cogger's first summary of the Australian herpetofauna of 664 species was published in 1975. While his early revisions kept in pace with taxonomic corrections and new additions to the fauna, which totalled 703 in 1979, 830 in 1983 and 865 in 1986, this fifth contribution is much more than the usual listing of the 951 currently recognised species. The book's format has changed considerably, as the author emphasises in the Preface. There are many more colour photographs and line drawings, and these are placed adjacent to the relevant text. Further, the dichotomous keys are more detailed and extensively illustrated, which greatly facilitates accurate identification.

The Introduction section to this edition briefly covers such topics as proper scientific and common names, species and subspecies, conservation, collecting, husbandry, preservation methods, and snakebite and its treatment. The extensive amphibian and reptile sections which follow are organised according to the author's opinions and attitudes concerning systematic herpetology. The focus is on the identification of species. There is a separate section devoted to the terrestrial reptiles of Australia's Indian Ocean Territories, and the book concludes with an appendix summarising the very latest additions to the Australian fauna, a glossary to those biological terms likely to be unfamiliar to the general reader, selected references arranged by major taxonomic group, and an index to scientific and common names. This edition is impressive for the completeness of its species survey and the extraordinary quality of the colour photographs, the register being superb. Thus, it is both a useful and beautiful book!

There are few distractions in presentation - some photographs are of dead (posed) specimens, maps are occasionally too small to reveal important details of geographic range and not all restricted distributions are pointed to with arrows, several drawings lose their clarity with fading lines (e.g., pp. 481, 630, 668 and 688), and a few "shadow" lines have not been masked out (e.g., p.631). Also, I would have preferred a more uniform placement and sizing of photographs, without loss of page numbers and narrow margins of some pictures being carried over to the facing page. There are few omissions, but the missing descriptions of tadpoles are noteworthy. The rich knowledge of frog acoustic signals is also rarely documented. Such sources of information are known to be important in identifying species and therefore should not be overlooked in future editions.

I have two general concerns. The author endorses the biological species concept, that which is based on the ability to interbreed, but he does not allude to any of its recently exposed philosophical and practical shortcomings. In any case, I believe a phylogenetic species concept is more in keeping with the book's focus on lineage identification. Secondly, I must take issue with the author's assertion that the recognition of supraspecific entities and the application of a taxonomy that reflects their relationships are intrinsically subjective (p. 19). Such a position ignores considerable theoretical and empirical research. Indeed, there has been a major revolution in systematics in the last 25 years, with cladistics being the clear winner of those debates. Systematists now have the intellectual and technical tools for real discovery, as objective as any in science, and it is generally accepted that a monophyletic taxonomy of proper names must be applied in order to accurately reflect interspecific relationships. Thus Cogger's emphasis on the purely legalistic aspects of taxonomy, including categorical ranks (p. 24), seems particularly out of place in today's literature, and it should come as no surprise that the supraspecific taxonomy employed in this book may be viewed as problematic. For instance, at

the higher taxonomic levels, snakes continue to be presented as if they are not lizards, and pygopods as if they are something other than gekkos. Problems occur at lower levels as well. For example, whilst the *Underwoodisaurus* group of gekkos is recognised as an entity exclusive of *Nephrurus*, the readily diagnosable *Strophurus* species group goes unrecognised. Consider also that Cogger's recognition of *Lucasium* as a genus of gekkos almost certainly renders *Diplodactylus* an unnatural entity. While it is an understatement to say that we have a long way to go in understanding the natural classification of all amphibian and reptile species, there are some relationships which are well founded and deserve to become a part of the secondary literature, such as field guides and like synopses. As young investigators use this book for identification they must be aware of the likelihood that the among-species generalities they formulate will be influenced by an out-dated attitude toward systematics.

Still, Hal Cogger is to be commended for the incredible effort he has put into accurately summarising the herpetofauna of Australia and making its identification relatively easy. I would not be without *Reptiles and Amphibians of Australia*. I look forward to the next edition where those species will be both beautifully illustrated and all levels of diversity scientifically presented.

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BOOK REVIEW
SNAKES OF AUSTRALIA. DANGEROUS & HARMLESS.

by P. Mirtschin & R. Davis. Hill of Content, Melbourne. 216pp.

This book is the latest of a long series of identification guides to the Australian snake fauna, most of which present similar types of information in similar ways, but differ in the geographic or taxonomic coverage and the quality of the data presented. Among its predecessors in the last two decades alone are Gow (1976, 1989), both Australia-wide, full taxonomic coverage compilations, Storr *et al.* (1986), Swan (1990), Weigel (1990) and Coventry & Robertson (1991) among the regional field guides, and Gow (1982) and Mirtschin & Davis (1982) among the guides to dangerously venomous species. When one adds to this list the ecological approach to snakes presented by Shine (1991) and the various more complete guides to the Australian reptile fauna (Cogger, 1992; Wilson & Knowles, 1988; Ehmann, 1992), it seems that the snake book market is rapidly approaching saturation point.

So what does this book offer that is any different to the other literature? Relatively little, so far as I can determine. The authors' avowed intent (p.7) is to present a field guide designed to assist in identifying snakes and also to provide a summary of all the available information about these species. In attempting to fulfil these aims, the authors present initial brief comments on beneficial interactions between the Australian snake fauna and man (mostly from the point of utilisation of the snake fauna for commercial, medical and educational purposes) and on methods of identification of snakes. Following these, the majority of the book (pp. 14-184) consists of single page accounts of the various snake families and species. The species accounts consist of common name and scientific name headings, a statement indicating the venom toxicity from the human risk viewpoint, a distribution map and (in most cases) a colour photograph, a brief description covering coloration, maximum size and scalation, and brief comments on the habits and preferred habitat of the species. Where subspecies are recognised, these are listed at the end of the account, and diagnostic differences are given. Following the species accounts is a short section on first aid treatment for snake bite and a more extensive section (pp. 187-198) on the conservation of Australian snakes. This latter section comments

on the problems in conserving Australian fauna, lists the species of snake considered by the authors to be endangered, provides an admirable commentary promoting the many contributions of amateurs to knowledge of the Australian snake fauna and to conservation, and gathers together a series of quotes from a wide range of sources to support the authors' views.

The authors have deliberately excluded "complicated keys" and instead recommend examination of the colour photographs as an initial aid in identification, followed by the descriptive account. However, the usually single photograph provided for each species is in most cases a whole animal photograph reproduced at small size, and while the colour reproduction is good, it does not show sufficient detail of such features as head markings to accurately identify most species.

The species accounts are well-written in most cases, with parallel construction and similar detail. However, there are some notable omissions and inconsistencies. The typhlopid snakes are largely excluded (only four species of a fauna of over 30 species), "due to space and relative interest", although all elapids, no matter how small, poorly-known or remotely distributed, are included! No distribution map is provided for *Glyphodon barnardi*, nor is there any textual indication as to distribution for this species. The risk assessment appear to be inconsistently applied. For example, *Cacophis* species are listed as "venomous, not dangerous" while other small elapids of similar low danger are simply listed as "venomous". *Demansia atra* is listed as "venomous, potentially dangerous", but the very similar, closely related but larger *D.papuensis* is simply "venomous". The accounts of subspecies generally do not indicate the geographic differentiation, one of the major bases for subspecific recognition. Most irritating to me was the inconsistent taxonomic treatment of the black-headed snakes, recently assigned (Hutchinson, 1990) to the genera *Suta* and *Rhinoplocephalus*. Leaving aside differences in opinion as to taxonomic status, between pp. 104-107, the species *bicolor* and *spectabilis* are assigned to the genus *Rhinoplocephalus*, *nigriceps* is listed as *"Rhinoplocephalus (Unechis) nigriceps"* and *boschmai* is listed as *"Rhinoplocephalus boschmai (Unechis carpentariae)"*. The remaining species in the complex are listed elsewhere (pp. 123-127), all as species of *"Unechis (Rhinoplocephalus)"*. It is not clear whether the authors are merely providing an alternative generic name, or using a subgeneric classification that the parentheses in such situations formally indicate. Whatever the intent, the result is chaotic.

As with most similar field guides, a major problem of this book is the lack of referencing applied to the data presented. Apart from photographer acknowledgments, no indication is given as to the locality for the specimen photographed. While this may not be relevant to the general public reading the guide, it does not allow the more experienced reader to relate any color variation to distribution.

Similarly, the data provided in the accompanying text is unreferenced, apart from a general list of references at the end of the book. Thus, the source of the data is not immediately clear in many cases. While some data are clearly the authors' own (e.g., the observation of a woma stalking dingo pups, p.18), and much is clearly taken from the primary literature, there remains a substantial body of data of unknown provenance. Much of this latter data appears to be extrapolation from knowledge of related species, leading in some cases to some bizarre statements (e.g., the comment on p.43 on the diet of *Cryptophis pallidiceps*, exactly the same as the diet listed for *C.nigrescens* on the previous page, even the inclusion of *Drysdalia* and *Notechis* spp. in the diet; neither genus reaches the northern distribution of *C.pallidiceps*). Along the same lines are the clutch size of "6-10 eggs" common to all *Glyphodon* species and the viviparity assigned to *Suta ordensis*, when data are not available in the primary literature. In some cases, the data presented are erroneous (e.g., the statement that *Rhinoplocephalus bicolor* is oviparous - see in contrast Shine, 1986). The authors point out in their introduction that there are many gaps in our knowledge of snakes, and promote the dissemination of new information. Surely that view is best promoted by not creating assumptions.

To be fair, it should be stressed again that these general criticisms can equally be levelled at many of the competing guides to Australian snakes.

More disturbing are the numerous errors in this book. Apart from spelling and typographical errors (e.g., *Liasis "olivaceous"* [p.23, but not elsewhere], *Mus "musculous"* [consistently], *"Stegnotus parvis"* [p.198], *"Pseydonaja"* [p.215] and *Unechis "cerpentariae"* [p.215]), the maps show many errors (e.g., the exclusion of *Morelia spilota imbricata* from south-western Australia, absence of *Austrelaps* from Tasmania, broad overlap in distribution given to the two species of *Furina*, inclusion of the Adelaide region in the distribution of *Drysdalia mastersi*, extension of the distribution of *Drysdalia coronoides* to include coastal NSW as far north as the Queensland border, extension of *Hemiaspis damelii* into Victoria, incorrect distribution in NSW for *Rhinoplocephalus spectabilis*, transposition of maps for *Unechis dwyeri* and *U.flagellum*). In a book primarily intended as a field guide, the high frequency of such distributional errors is inexcusible.

In summary, the experienced herpetologist will find little of interest in Snakes of Australia. However, as a field guide for the inexperienced, the main objective of the authors, it will be useful, although offering few new or novel features over those already available, and carrying hidden traps for the unwary. Certainly, it is competitively priced at $24.95.

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